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SINGLE-PHASE ELECTRIC TRACTION ON THE ROCHESTER DIVISION OF THE ERIE R. R.

By W. N. SMITH,* Assoc. M. Am. Inst. E. E.

One of the significant electric railway developments of the present year was the change from steam to electric motive power on a portion of the Rochester division of the Erie R. R., in New York state, on June 18. It is evident that this antedates slightly the commercial operation of the high tension system on the New York, New Haven & Hartford R. R., and the claim may justly be made that this is the first single-phase alternating current system of electric traction, upon a steam railroad, to go into commercial operation. It follows, of course, that this system was the first to put into commercial service an 11,000-volt trolley wire in this country and the first heavy traction system drawing power from a 60,000-volt transmission system.

The section of track equipped is 34 mi. long, extending from Rochester over the main line of the Rochester division to Avon, a distance of about 19 mi., thence 15 mi. over the Mt. Morris branch. The railroad is entirely single track, with sidings at way stations, averaging 3 to 4 mi. apart. The grades are light, and the curvature for the most part quite easy, the line being relatively very straight.

The line was originally laid with 68-lb. rails, but was relaid with 80-lb., taken from another division just prior to the electrification. The roadbed is ballasted with gravel, and the joints are of the Weber type. A single bond of comparatively small size (equivalent to No. 0000, B. & S. gage) is applied at each rail joint under the fish plate. It will be remembered that, with this system, small bonds are considered permissible on account of the comparatively small current and the high impedance of the main circuit. The line crosses several bridges.

The electric service is for local interurban passenger traffic. The principal villages served are Avon, Geneseo and Mt. Morris, the other regular way stations being little else than cross-road stops. The population is entirely agricultural, and the Genesee Valley traversed by this line is one of the most beautiful and prosperous farming regions in New York State. The freight service is handled exclusively by steam as heretofore, as are also the through trains operating between Rochester and Corning over the main line of the Rochester division, a distance of about 94 mi. The steam service between Rochester and Mt. Morris originally comprised three round trips daily. Instead of three round trips per day, the electric service has introduced six complete round trips between Rochester and Mt. Morris, and three more between Avon and Mt. Morris.

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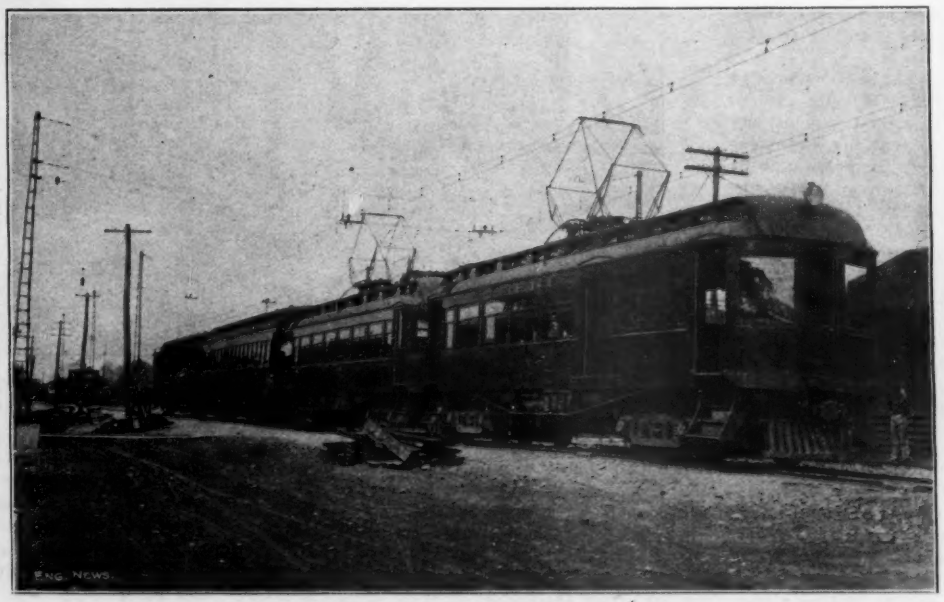


FOUR-CAR ELECTRIC TRAIN, ERIE R. R.

POWER SUPPLY.

TRANSMISSION LINE.—The power comes from the Niagara Falls plant of the Ontario Power Co., over the lines of the Niagara, Lockport & Ontario Power Co., as three-phase current at 60,000 volts. A branch line from this system was built along the Erie right-of-way from Mortimer, about 4 mi. south of Rochester, to Avon, where the main substation is located. The pole construction upon this branch transmission line is of the A-frame type, using two 40-ft. cypress poles, set abreast of each other, and inclined so that their tops are framed together, the butts being joined by horizontal plank braces underground. The cross arms consist of two 3½ × 6-in. timbers, 8 ft. long. The insulator pins are of cast steel, one being placed at the apex of the A-frame and the other two bolted near the extremities of the cross arms, so that there is an equilateral spacing of 7 ft. between each of the three wires. This construction is shown in Fig. 2, at the right of the track. The standard length of span between A-poles is 220 ft., which is shortened at curves when necessary. The conductors are of No. 4 hard drawn, stranded copper cable. When crossing over the tracks of the Erie, or other railroads, recourse is had to a special construction of No. 0 copper cables carried on steel towers, so reinforced by guys that it is impossible for a failure of the line to result in dropping the conductors across railroad tracks. The insulator pins are grounded by copper wire. The neutral of the transmission system is grounded at the power station through a resistance. Lightning protection of the horn arrester type has been installed at every fifth pole.

SUBSTATION.—The substation building is adjacent to the roundhouse and division shops at Avon. The building is entirely fireproof, having brick walls on concrete foundations, roof and floors of reinforced concrete and doors and windows of kalamein construction, fitted with wire glass.

The main floor is divided into three rooms: a main transformer room, 42 × 17 ft., of the full height of the building; a high tension room 17 ft. 4 ins. × 19 ft. 8 ins.; and the operating room, 19 ft. 8 ins. × 24 ft. Directly over the operating room is a mezzanine floor on which are located the 11,000-volt lightning arresters, the 60,000-volt series transformers and choke coils.

There is a space in the transformer room for another transformer of the same size and there is also space in the high tension room for an oil insulated circuit breaker should it ever be considered necessary. The interior is painted with cold water paint of the same light green shade that is commonly used by the Erie R. R. for interior finish.

The transmission line terminates at the lightning arrester yard in the rear of the substation. The arrangement of the 60,000-volt lightning arresters consists of three horn gaps, arranged one behind the other, on each of the three conductors, the first gap being 4¾ ins. across, the second 5 and the third 6 ins. A concrete column is in series with the first gap, an electrolytic arrester in series with the second and a 5-ft. fuse of No. 18 copper wire in series with the third, that is to say between one horn and the ground. Both horns of each gap are of ½-in. round iron. Between the line and the first arrester there is a hook-type knife switch, and between the last arrester and the lead into the substation is a No. 18 copper wire fuse, in each conductor, placed horizontally upon the structure especially devised for it on top of a pole. These fuses are enclosed in wooden tubes about

5 ft. long, wrapped with torpedo twine. The entire arrangement of lightning arrester gaps, fuses and switches is mounted upon 18 chestnut poles; and a suitable elevated platform, railed off and fitted with a gate to keep out trespassers, affords means of access to the apparatus when attention is required.

The three high-tension conductors enter the substation through glass disks held in 36-in. tile, set in the upper portion of the rear wall of the substation. Within the substation the wires first pass through three 60,000-volt, stick-type, circuit breakers, mounted directly inside of the rear wall, over bare copper conductors to three oil-insulated choke coils on the mezzanine floor, thence to three oil-insulated, series transformers, also on the mezzanine floor, from which connections are taken to the power measuring instruments in the operating room. The main connections pass to a set of copper bus bars in the transformer room.

The 60,000 three-phase current is rendered available for single-phase distribution by means of three 750-KW. Westinghouse transformers of the oil-insulated, water-cooled type. For the present installation, only two transformers are used at one time, the third being a spare. The transformer windings are fitted with taps enabling the three-phase to two-phase "Scott connection" to be used. The necessary transformation from three-phase to two-phase, fits in very well with the natural sub-division of the electrified line, into two sections, one of which is about 19 miles in length, north of Avon, the other about 15 miles in length, being to the south of Avon. The connections were, therefore, laid out to operate such sections upon separate phases of the two-phase secondary system. Either the T or V connection can be used, the latter method being employed at present. Each one of the active transformers therefore feeds a separate section.

The low tension windings can be so connected that either 11,000 volts or 22,000 volts can be obtained, so that in case it should ever be desired to transmit railway current for an extension of 40 or 50 mi., to another substation it could readily be done without adding transformers to this equipment. The low tension windings also have six taps, enabling relatively small variations in the secondary voltage if the same should be necessary to suit operating conditions in the trolley line. One end of each low tension winding is directly grounded to the boiler iron case, which in turn is, by means of a No. 0000. stranded copper cable, directly connected to the track return circuit.

The transformer cases are made of boiler iron, and set on a square cast iron base, which is in turn mounted on three pairs of wheels running upon an iron sub base set in the concrete floor of the room. A track runs lengthwise of the room directly in front of the transformers, a transfer truck running upon it, upon the top of which there is another set of little wheels or rollers, which line up with those upon which the transformer cases are set. At the rear end of the transformer room a 10-ton hand hoist is provided which is able to lift any part of the transformer that repairs may make it necessary to handle.

Two cylindrical boiler iron oil tanks are provided, each of slightly greater capacity than a single transformer. One is located in the basement directly under the transformer room, so that the oil from the transformer can readily be drained into it. The other is suspended from the concrete roof beams at the top of the transformer room, close to the side wall of the building, this being intended to act as a reservoir for distributing oil back into the transformer. The oil is pumped from the lower to the upper tank by means of a steam pump supplied from the boiler room in the adjacent division roundhouse, where steam is always available. From the upper tank oil is fed by gravity into either transformer. It is thus a simple matter to draw the oil off from any transformer if its insulating qualities are found to have depreciated, and the dehydrating, filtering or purifying apparatus can readily be employed with the aid of the pump, and the supply returned again to storage. The oil piping is of iron throughout.

The water circulation is by gravity, the supply coming from the railroad company's water tank system, at the adjacent round house, being pumped originally from the Genesee River about a mile distant. There are three separate water cooled coils in each transformer case, each one controlled by its own valve, so that the amount of water may be controlled as found necessary under various conditions of load.

As mentioned above, one terminal of each single-phase 11,000 volt transformer is grounded. The middle transformer of the three is ordinarily used as a spare, and the other low tension lead from this transformer runs to the center of a double throw switch, whose outside poles connect separately to two low tension bus bars. The ungrounded low tension terminals of the other two transformers connect through single-pole switches, one to each of these bus bars. The low tension bus bars run along the wall of the operating room, and directly beneath them are three Westinghouse automatic oil circuit breakers, one one each of the two trolley feeders, the third breaker which is situated between the other two being a spare. One pole of each of the three circuit breakers is connected to the center pole of a double-throw, hook-type knife switch, by means of which it is thrown upon either bus bar. The other pole of the circuit breaker runs directly to the feeder. The outgoing lead from the middle or spare circuit breaker, can instantly be thrown upon either one of the feeders, should the circuit breaker usually controlling that feeder be temporarily disabled. This system is shown in the diagram Fig. 4.

The outgoing 11,000 volt feeders run up to the mezzanine floor directly over the operating room, where they emerge from the building through perforated glass disks, set in 18-in. round tiles. Before emerging there are tapped to them two Westinghouse low equivalent lightning arresters, set in brick compartments, and reinforced by two electrolytic lightning arresters of the 11,000 volt type. A set of call bells is provided so that when the automatic breakers open, a bell is rung in the car inspection shed, adjoining. Also, if the temperature of any transformer runs above normal, a bell circuit connected to a thermometer in the top of the transformer tank is similarly made to operate. The station itself does not require the continuous presence of an attendant, which is needed in the case of a rotary converter substation. The working force is so organized that the car repair men are always available for manipulating the substation circuit breakers, and the cost of attendance is thereby reduced to a minimum.

OVERHEAD CONSTRUCTION.

The catenary construction is in many respects unique. As there were very few precedents to follow, many of the details of the overhead work are entirely original and nearly all of them were specially designed for this installation.

SUPPORTS.—The poles are of chestnut averaging 25 in. in circumference at the top, and about 42 in. at the butt. Most of them are about 35 ft. long, but 40 ft. poles were used where the embankments were narrow and steep, and in span construction. Nearly all the construction is of the bracket type, except at the railroad yards at Rochester, Avon, and Mt. Morris, and for some distance at Mortimer, where there is a siding on each side of the main track, which prevented the use of bracket construction. The poles are given about 12 ins. rake. The poles are tamped with cobblestones, of which plenty were available from the coarse gravel with which the road is ballasted. The ground proved very deceptive as regards the nature of the digging, much water bearing gravel and quicksand being encountered, and oil-barrels had to be resorted to in many instances to prevent caving in of the holes during pole setting.

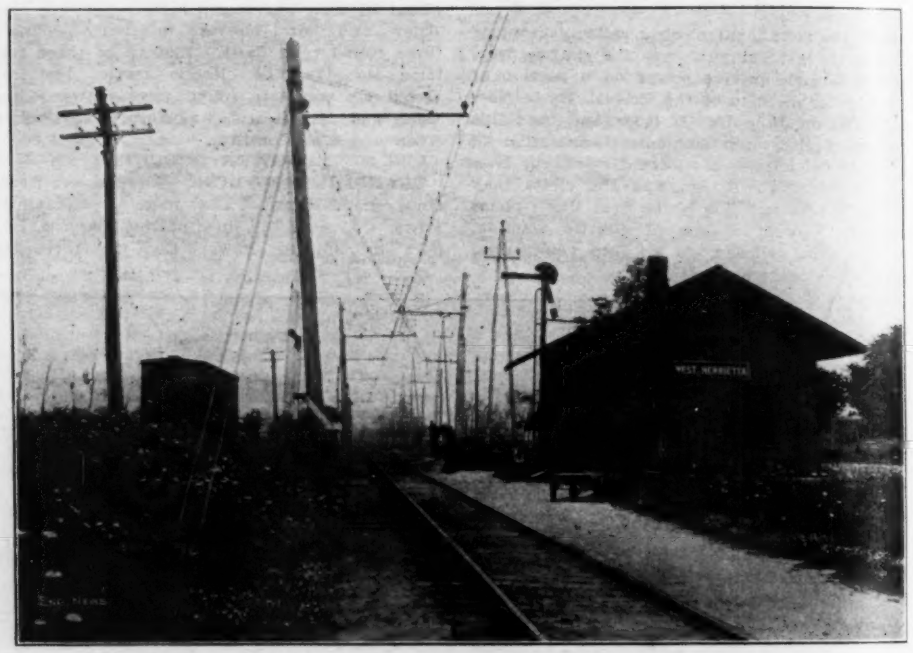


FIG. 2. OVERHEAD CONSTRUCTION, ERIE R. R. ELECTRIC TRACTION; SHOWING STANDARD BRACKETS, TURNOUT DEFLECTORS AND HIGH TENSION TRANSMISSION LINE.

BRACKET CONSTRUCTION.—The bracket, an entirely original design, consists of a 3 × 2½-in. T, 10 ft. long, the heel of which is fastened to the pole by a pair of bent straps, the outer end being supported from the pole top by two ⅝-in. steel truss rods, instead of the single rod commonly used. The two rods are attached about 27 in. back from the outer end, and run to each side of the pole, and are fastened there to a pole clamp which grips the top of the pole instead of requiring the bolt or truss rod to pass through it. In this way the timber is kept intact, and there is no hole to admit moisture and to induce rot. The two truss rods are threaded at both ends and at the upper end each one passes through a small iron casting which is in turn carried upon a bolt projecting out from the cast iron portion of the pole clamp, like a trunnion. The whole construction is extremely rigid, and is stronger and more conducive to a long life for the pole than any bracket before developed. Where necessary, at switches, extra long brackets are employed, being lengthened by splicing and an extra truss rod being attached by means of a clamp, to the outer end of such a bracket, and run to the extreme top of the pole. The ordinary bracket construction is shown in Figs. 2 and 6.

The insulator pins are of malleable iron, of a

type specially devised for this work. The lower portion of the pin is divided and fitted closely over the flanges of the T bracket, being provided with a single ⅝-in. bolt by means of which the lower split portion of the pin is clamped securely against the bracket.

The insulator is of special design, 6⅞ ins. in diameter and 6 ins. high, of the three petticoat type, but made in two parts cemented together. As most of the overhead work was done during the winter months, and had to be rushed, a quick setting mixture of litharge and glycerine was used in place of Portland cement.

The insulator pins are ordinarily about 12 ins. from the end of the bracket, but there is 27½ ins. space between the end of the bracket and the point where the truss rods support it, which enables sufficient variation in location of insulator to meet most of the requirements in shifting the alinement of the trolley wire on curves.

CATENARY LINE.—The messenger wire is of seven-strand "extra high strength" steel and is of 7/16 in. diameter. Joints are made by using the so-called "open" and "closed" cable sockets, the sockets being sweated on to the abutting ends of the cables and joined by a pin connection through the eyes of the sockets. The trolley wire is No. 000 B. & S. grooved copper, the lengths being spliced with the usual type of soldered splicing sleeve.

The spans on the straight line track are 120 ft. in length, and as much shorter than this on curves, as required by the radius of the curvature. The maximum deflection from the center line of the track, on curves, is 7 in., each way. The catenary hangers are assembled drop-forgings spaced 10 ft. apart. The messenger clip and the trolley clip are of the same type but grooved differently to accommodate their respective wires. They are joined by a ⅝-in. iron hanger-rod, with right-hand threads on each end, the longer rods being flattened in the middle to admit of bending them slightly, so as to conform to the divergence of the messenger and trolley wire near the ends of the spans. Both trolley and messenger ears are secured in position by jam nuts. This type of suspension was developed especially for this installation, and is so constructed that there is no possibility of parts coming loose and falling apart on account of vibration. The general hanger construction is shown in Fig. 5.

"Steady strain-rods," to prevent movement of the trolley wire about the catenary, are provided. These are mounted at one side of the bracket, instead of directly underneath, in order to give sufficient clearance for the ends of the pantagraph bow on curves where the super-elevation results in the tilting of the shoe from the horizontal. Each steady strain-rod is hinged to a spool-type porcelain strain insulator clamped to one side of the bracket in such a manner that the hinged end of the rod is almost at the elevation of the top of the T bracket. The method of attaching the steady strain insulators to the bracket is such that they can readily be shifted along the bracket to follow up any change in alinement of the trolley wire that may be required by curvature or for any other reason. The clamps holding the steady strain-rod insulators are of 3 × ⅜-in. bent iron. The spool-type insulators are cemented on to pieces of ¾-in. pipe, through which passes the ⅝-in. eye bolt by means of which they are attached to the bent irons. Steady strain-rods are used only on curves and turnouts and were not found necessary on tangent track. Their use is shown in Fig. 8.

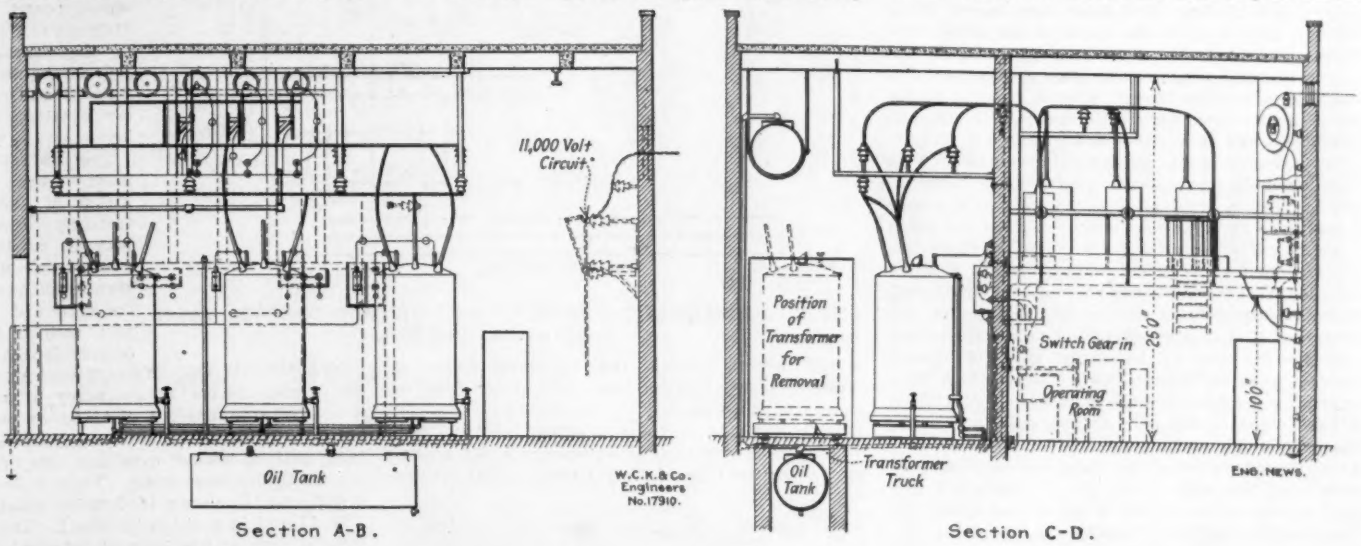


FIG. 3. PLAN AND SECTIONS OF ERIE R. R. SUBSTATION AT AVON, N. Y.; SHOWING GENERAL ARRANGEMENT OF APPARATUS.

Light tie wires (No. 9 Extra BB, galvanized telegraph wire) were used because it was thought best not to make too rigid an attachment between the messenger wire and the insulator; so that if a bracket became detached from the pole for any reason, its weight and the shock of detachment would tear the wire clear from the messenger and allow the bracket to fall entirely away from the wire so reducing the chance of interfering with steam trains.

An accident to the electrical equipment of a railway operating both steam and electric trains, may shut down the electric service, but will not automatically place any check upon the steam service, so that accidents to steam trains must be guarded against. This special requirement for safety was one of the reasons for installing the system of connecting the brackets to the rails as shown in Fig. 7. The "ground rods" consist of ⅜ × 1¼-in. flat steel, with their upper and lower ends bolted to trolley bracket and track rail respectively. The system was carried out consistently throughout the installation. Every bracket is grounded to the rail, so that an insulator failure will instantly throw off the power (by tripping a circuit breaker), as it will cause a complete metallic short-circuit. There is thus no danger of setting the wooden poles on fire, which would be possible if this precaution were not taken. The burning of a wooden pole would not of itself necessarily cripple the electric service, but it would be quite likely to cause an obstruction dangerous to the passage of steam trains which are, of course, independent of any disturbances on the electric motive power system. Up to the present time, however, there have been no cases where the overhead construction has caused any obstruction to the passage of the steam traffic.

SPAN CONSTRUCTION.—The span construction shown in Figs. 8 and 1, is as nearly as possible similar to the bracket construction, and uses the same type of pin and insulator. A piece of 3 × 2½-in. T about 30 ins. long is suspended from the span wire by hangers of galvanized strand cable, adjustable in length and fastened to the span wire cable by specially designed

clips, the construction forming a sort of stirrup upon which the pin and insulator are carried. The messenger wire rests upon the insulator just as in the case of regular bracket construction. This form is used, not only for single track spans but in the yards at Avon and Rochester where three or four parallel tracks are electrified. Span construction, in general, was used only where conditions absolutely required it.

The Rochester yard was a difficult piece of construction on account of the distance between supports (which reaches a maximum of 94 ft. spanning seven tracks, four of which are electrified) and also on account of the uncertain nature of the soil which, on the river bank, is a fill of gravel and cinders. For these long spans, where it was impossible to use guys of the usual type (the river bank being on one side and on the other the main highway to give access for loading and unloading freight cars) it became necessary to use an entirely self-supporting span construction, and this was done by using the "Tripartite" type of steel pole, set in concrete. This type of pole, constructed of re-rolled Bessemer steel rails, is less subject to rust, and consequently more durable than any other available type of metal pole, and all of its surfaces are always open and easy of inspection. On account of the great tensile strength of the material, there is considerable saving in weight, and the fact that it was a standardized product, enabled quicker delivery to be made than if special riveted poles of structural steel shapes had been especially designed for these locations. The span wires consist of the regular messenger cable fitted with cable sockets sweated on at each end, these being fastened to turnbuckles and pole collars at the tops of the poles. There are two span cables at each pair of poles, the upper one being used to carry the weight, the lower one acting to steady the arrangement and also to act as a relay in case of an accident to the upper span.

A very simple type of pull-off was devised for curves in span construction, and it so happens that both the Rochester and Mt. Morris yards have considerable curvature. The pull-off consists simply of a spool-type insulator, with a piece of pipe cemented through the center, this pipe being slipped over the hanger spacing rod joining the messenger and trolley clips, thus giving an insulating connection through which an ordinary pull-off cable can be attached to both messenger and trolley, wherever required. The division of the horizontal pull between the messenger and trolley wires is easily adjusted by shifting the spool type insulator up and down the spacing rod, by inserting longer or shorter nipples of pipe underneath it. In general, when near a span wire, the messenger cable is supported rigidly on its insulator and the trolley wire needs all the side pull; but in the middle of a span, the pull must be equally divided between messenger and trolley wire. The use of the pull-over is well shown in Fig. 8.

LOW-BRIDGE CONSTRUCTION.—The presence of several through truss bridges over streams, and two low bridges over the Erie right of way, necessitated the employment of special construction at these points. The bridge at Clarissa Street, on the outskirts of Rochester, was particularly troublesome. The original clearances here were so low that the roadbed had to be excavated out and the track lowered about 2 ft., the minimum clearance between the rails and the trolley wire being finally 18 ft. In such construction the messenger cable is fastened to a horizontal spool-type insulator mounted at the center of a substantial piece of turned oak, which is long enough to carry two more similar insulators, one on either side of the center one. The steel hangers reaching down from the overhead bridge structure, carry the two side insulators, so there are always two insulators in series between the 11,000 volt messenger cable and the steel work of the bridge. These insulated supports are suspended at short intervals from the under side of the steel work of the bridge, and are further supplemented by the use of steady strain-rods to prevent any side displacement of the trolley wire. The shortest sizes of hanger spacing rods are used in such places. Low-bridge construction is shown in Fig. 9. Where the bridge trusses are high enough to permit it an iron stirrup is employed like that used in span

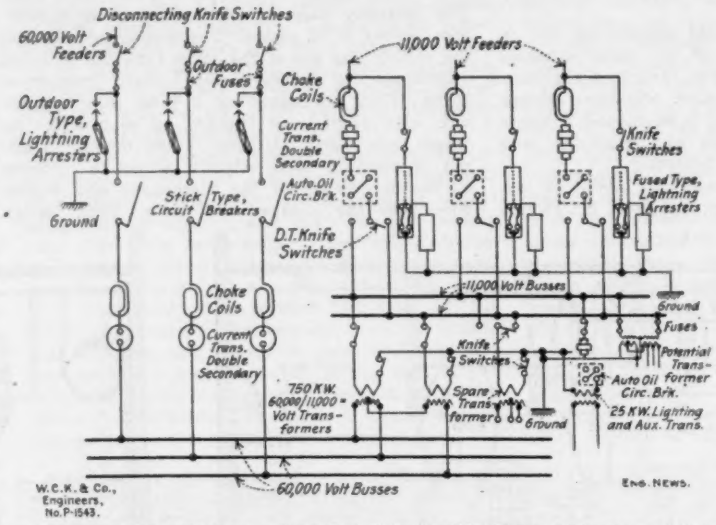


FIG. 4. DIAGRAMMATIC SCHEME OF SWITCHBOARD CONTROL, AVON SUBSTATION, ERIE R. R.

work, which carries the standard form of straight line insulator, and the regular type of catenary suspension.

At either side of these overhead obstructions, it was necessary to provide warnings, for brakemen upon the tops of freight cars, as substitutes

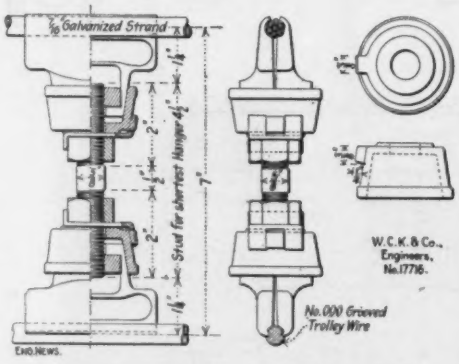


Fig. 5. Trolley Hanger for Catenary Line.

for the warnings of hanging pieces of rope previously used. In Fig. 9 is shown the approach to the Clarissa Street bridge, with both the old arrangement of ropes and the new scheme for electrified tracks. It will be noted that at this point only one of the two tracks is electrified and freight trains are here obliged by rule to use the unelectrified one. But to insure that the place shall be absolutely safeguarded the electrified track is fitted with warning signs of the type shown. They consist of a common type of horizontal suspended swinging wooden rod, mounted with its axis at an angle, so that it swings up as it is pushed to one side. The pantagraph trolley is fitted with a set of springs on each side, one of which strikes this warning sign a blow as it passes under and instantly throws it to one side. The blow is struck upon a heavy leather strap held taut by a coil spring of steel wire in tension, the whole contrivance being fastened to the lower half of the pantagraph trolley mechanism so that it is at the right height for striking the warning sign.

The swinging rod is mounted upon the pole by means of insulators, effectually preventing any leakage to the ground, even though a car might stand still directly under the sign and make contact with it for an indefinite length of time.

OVERHEAD CONSTRUCTION AT SWITCHES.—Some device is necessary at turnouts or cross-overs to prevent the end of the collector bows of a train approaching converging wires, from getting hooked over one wire and catching at the trolley-frog angle. Such a device, called a deflector, is shown in detailed construction by Fig. 11 and in position by Fig. 2. This type consists of four or five bars of flat steel, ½ × ¼ in., suspended by riveted hangers from crossbars spaced 5 ft. apart, which in turn rest on standard trolley clamps fastened to the trolley wire. The particular advantage gained by this construction is that no extra tension is needed to keep the bars from sagging and getting crooked, this type of deflector being of minimum weight and entirely self-contained. They are placed in both angles of each switch.

LINE SECTIONS.—The line is divided into seven sections:—One comprising the Rochester terminal, one the Avon yard, three sections in the main line between Rochester and Avon, and two sections south of Avon. The sections are divided by trolley section insulators as shown in Fig. 9. They are of the overlapping type, made of impregnated wood, and are of sufficient length to insure insulation at 11,000 volts. Each section insulator is carried upon two brackets, mounted on poles spaced 10 ft. apart. As the trolley and messenger must both be completely

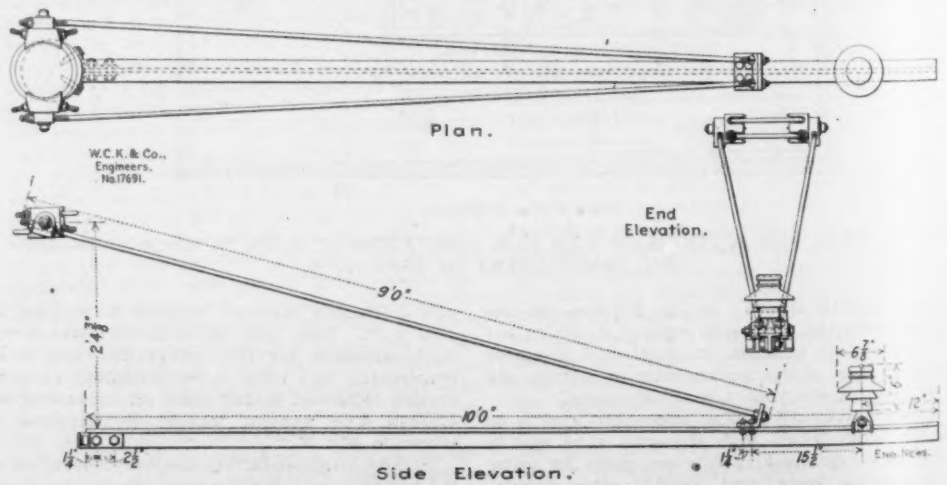


FIG. 6. DETAILS OF BRACKET SUPPORT FOR CATENARY LINE.

insulated on opposite sides of the break, heavy strain insulators are introduced upon which the messenger is dead ended, the two insulators being connected across the gap by a heavy steel rod. This entire combination is supported upon

standard insulators mounted upon the regular brackets.

One of the breaks, that opposite the substation at Avon, is different from the above mentioned type, in that the connections are not overlapping, it being necessary to absolutely separate the two halves of the trolley line in order to utilize the separate phases of the two-phase system as mentioned above.

The only feeders necessary are those connecting the substation with the trolley on opposite sides of this section break. The principal object of cutting the trolley into additional sections is to facilitate the locating of line trouble. The conditions of electric traction upon this line are such that no feeder is necessary besides the trolley line, and consequently there is no necessity for feeding the sections separately. A "jumper" connection is therefore provided, at each section insulator, in which is placed a hook-type knife switch that can be operated in case it is desired to cut that section out. Normally, however, the switches are closed and the effect of the "jumpers" is to make the trolley wire continuous.

WIRES OVER RIGHT OF WAY.—Nearly all the telephone and telegraph wires which would have crossed over the 11,000 volt trolley wire have been put underground. Where the line is crossed by heavy telephone trunk lines, they have been protected by the basket type of construction, so designed as to effectually prevent a broken telephone wire from falling across the messenger or trolley wire. This basket consists primarily of four galvanized steel cables stretched between opposite ends of two cross arms, one placed above and the other below the wires of the intersecting telephone line. The four cables are joined by a basket work of light strap iron ribs placed at intervals of 3 to 4 ft. across the whole span, forming the sides and the bottom of the cradle. This construction was followed in the case of an electric light circuit at Avon.

SIGNAL SYSTEM.—The telegraph department of the Railroad Company, in connection with the signal department, constructed a private telephone line of two copper wires between Rochester and Avon, with instruments at all signal towers and stations in the dispatcher's office, and at the substations, and car shed, and master mechanic's office. This telephone system is run upon the trolley bracket poles, transposed every third pole, and has worked satisfactorily. A positive block signal system has been installed for dispatching trains with the headway at which they are obliged to be run upon this single track road, which must also handle steam passenger and freight traffic at the same time. The blocks extend between the regular way stations, or if such blocks are too long, switch towers are added, making the blocks average about four miles in length from one end of the line to the other. Without going into detail it may be stated that the function of the positive block system is to absolutely prevent more than one train at a time from occupying a block. The sidings are fitted with interlocking switches controlled by the block operators, in the towers, or in the way stations, and the movement of trains is thus regulated with the greatest care. The towers are all connected by the private telephone line, while the way stations retain the usual telegraphic communication with the train dispatcher's office at Rochester. By means of the telephone communication, it is instantly possible for a train crew to get in touch with the chief dispatcher, and be properly located, but all train orders are transmitted by telegraph and written on standard forms according to uniform steam railroad practice.

TELEGRAPH SYSTEM.—As is well known, the single phase trolley system causes interference with telegraph lines, along the right of way, and unless the induction is properly compensated, there is always danger of telegraphic communication being seriously affected. The chattering of the relays is particularly annoying, as it is continuous, so long as the trolley line is connected, whether or not there are any cars moving. Various means were proposed, and tried, by the Western Union Telegraph Co., for the elimination of such troubles. The most successful, thus far known, is that due to Mr. E. W. Applegate, quadruplex expert for the Western Union Telegraph Co., who has developed a very simple means for overcoming "static interference" as the telegraphers term these troubles, The Applegate "static pickup," so-called, for which a patent is pending, is shown in Fig. 12. It comprises a back-contact relay, high resistance shunts and an auxiliary battery. The current enters the 150-ohm relay attracting the armature "C." The shunt "A" consists of 350 ohms of carbon stick and on account of the self-induction of the relay magnets provides a better path for the induced currents, that may be on the line, than does the circuit through the magnets. When the line is opened by any operator the armature "C" is drawn back by a spring to the back contact "D", so that both "A" and "B" are shunted with the main circuit, relieving agitation of the armature so that it can respond to the closing of the line.

The shunt "A" robs the relay of main line battery current very materially, so that it responds to the home key sluggishly. Consequently, the auxiliary battery "F" is inserted as shown. When the armature "C" falls back, this battery sends current through the magnets, and assists prompt response to any operator to such an extent that the shunt "A" does not cause noticeable drag. The armature spring is adjusted to overcome any current waves that the shunts "A" and "B" may not eliminate. The aid of the 7-volt battery overcomes this adjustment, and leaves the relay very prompt and satisfactory. The resistance of the shunt "A" must be determined by the electrical distance from the ground and battery at each end of the line. The nearer to the ground, the less should be the resistance of the shunt, as in close proximity to battery and ground, the trouble is more pronounced, and the effect of the main battery upon the relay is likely to be correspondingly diminished.

LIGHTNING PROTECTION.—Only a part of the line was equipped with line lightning arresters as lightning protection for high tension single phase railway lines is not, as yet, standardized. Those arresters used are of a Westinghouse swinging-fuse type of construction. This type of lightning arrester consists of a gap, one side of which is connected directly to the trolley through a No. 4 copper wire, the other side being directly connected to the ground rod, through a fuse enclosed in a tube which, while the fuse is intact, is maintained in an inclined position like a pendulum held back from its position of rest; but when the fuse is blown, a latch is released which allows the fuse tube to swing to a vertical position which shows conspicuously from the ground, and signifies to the patrolman that the fuse should be replaced. The fuse tube can then be lifted off the suspending lugs by a pair of insulating tongs made for the purpose, and the fuse renewed and replaced in a few moments.

On the other half of the line, lightning arresters were not installed. During the summer, two of the poles were struck by lightning but the

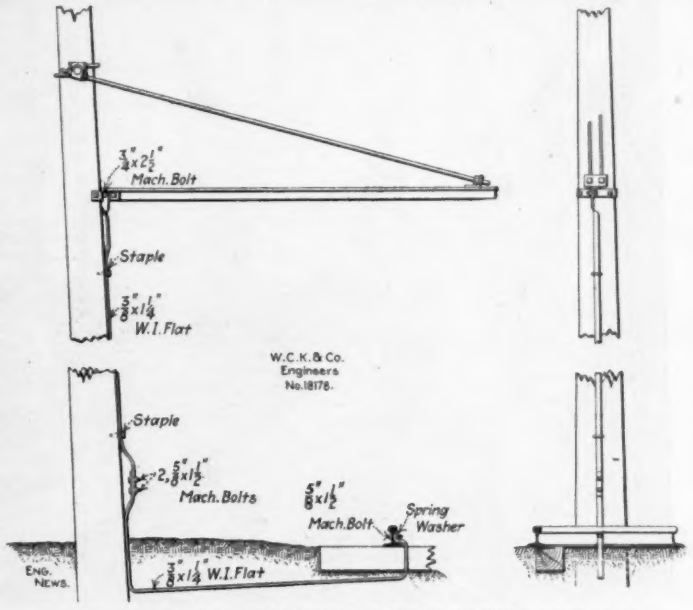


FIG. 7. BRACKET GROUNDING CONSTRUCTION, ERIE R. R.

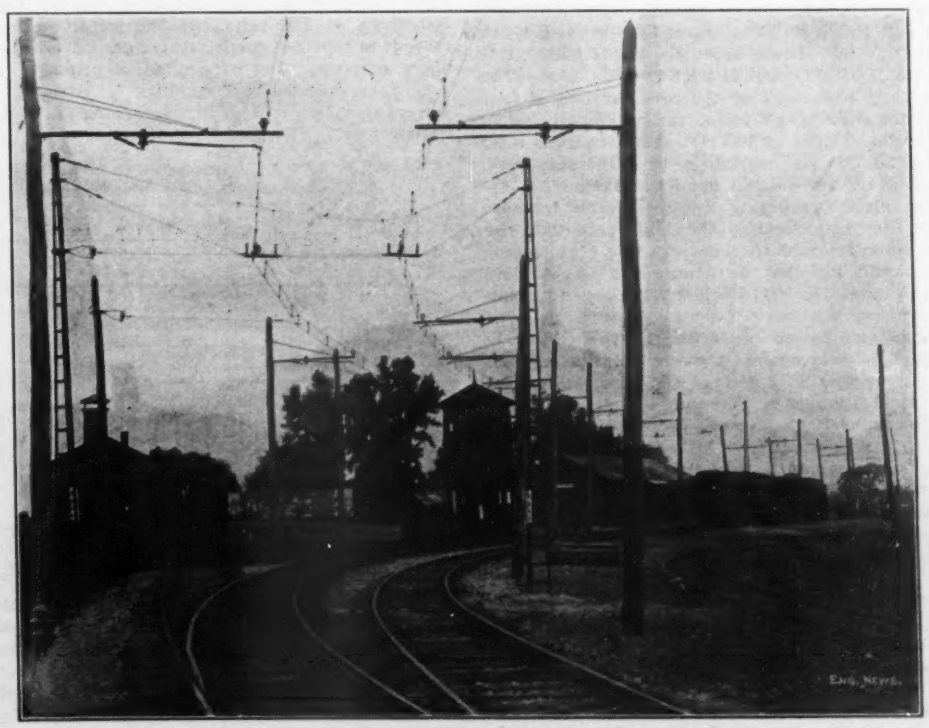


FIG. 8. STEEL POLE AND SPAN WIRE CONSTRUCTION, MT. MORRIS TERMINAL, ERIE R. R.

metal work of the brackets and truss rods being entirely grounded, these poles were not damaged below the topmost point of attachment of the truss rods, which is generally not over 18 inches from the top of the pole. In a number of instances the lightning arrester fuses have blown, but it is not known how many of them have blown simultaneously. Although the extent to which this type of arrester is fully protective, is hardly established as yet, it can be stated that at no time since regular operation started, has any injury to the car equipment resulted from lightning, though there were several severe storms during June and July.

MOTOR CARS.—The motor-cars are at present, six in number. They are 51 ft. 4 in. over bumpers; 40 ft. over corner posts; and 29 ft. 4 ins. between truck centers. They are 8 ft. 9 ins. wide over sheathing; and 13 ft. 8⅝ ins. in height above the rail. Four of the six have two passenger compartments, the other two having a baggage compartment about 14 ft. long, and a small smoking compartment with six seats, besides the regular passenger compartment. The bottom construction of the cars comprises side sills of 5 × 8-in. yellow pine, with 6-in. steel channel and fillers, intermediate sills of 4½ × 6-in. yellow pine, and center sills of 6 in. I beams, with fillers. All the cars have upper and lower truss rods and needle beams of 5-in. I beams. End sills are 8 × 6-in. oak. The flooring is double, and trap doors are fitted over the motors. Each vestibule is fitted with a double acting swinging door so arranged as to form the motorman's cab, and when not so used it is folded back to completely enclose the control apparatus and brake gear, and leaves the vestibule unobstructed for passengers.

Each car is fitted with two 50-c. p. headlights, gongs, air whistle, and with a standard train air signal used by the Erie Railroad. The cars are electrically heated. The "Standard" steel type of platform buffer is used, and the regular M. C. B. coupling, air hose connections and safety chains are provided, so that the cars can couple up to any of the standard Erie Railroad rolling equipment. There being an open space nearly 18 ins. wide, between the abutting vestibules when two motor cars are coupled together, due to the rounded platforms and projecting buffer beams, it seemed advisable to provide canvas curtains about 5 ft. high with snaps attached which enable them to be quickly stretched across the space, one on each side of the vestibule end door, so as to insure the safety of trainmen and passengers when walking from one car to another with the train in motion.

The trucks are of standard M. C. B. swing bolster type with heavy framing. The axles are 6½ ins. diameter. The wheel base of each truck is 6 ft., 8 ins. Brake shoes are inside hung.

ELECTRICAL EQUIPMENT OF CARS.—The electrical equipment of the cars consists of four Westinghouse single-phase railway motors, with a nominal rating of 100 HP. each, the gear ratio being 20:63. The suspension is of the nose type. Solid gears are pressed upon the axles.

The electro-pneumatic control system includes three distinct circuits; the high potential, the low potential and the control. The high potential circuit includes the pantagraph trolley, line switch and the transformer. The pantagraph trolley mechanism is operated by a pair of springs and by an air cylinder. The trolley is raised and held against the wire against its own weight by means of springs and it is lowered by the application of air pressure to pistons working in cylinders that form part of its base. When down it is automatically locked and the latch of this lock can only be withdrawn by applying air pressure to another small piston which then unlocks the pantagraph allowing the springs to raise it. This trolley mechanism is so connected with the control circuit through a line relay that any interruption in the supply of high tension current immediately causes the trolley to be lowered by applying the air to the main cylinders in the trolley base.

The line switch is equivalent to a main, high-tension, circuit breaker. It is opened and closed by air pressure, admitted by electrically operated valves. In case the supply of air is exhausted, as when the car has stood for some time unused, the line switch must first be held in mechanically by means of a handle provided for the purpose until the air pump, which can then be thrown into operation, has compressed air to about 50 lbs. pressure, which is enough to properly actuate the control system. To raise the trolley when there is no air pressure, there is provided a small automobile tire pump placed underneath one of the car seats, which is connected by a three-way cock into the trolley air-piping system, and enables the air operated trolley latch to be withdrawn and power obtained that will start the air compressor and set going the motor generator set, which is used for charging the storage battery and supplying current to the control circuit.

The transformer, of 200 KW. capacity, is of the oil insulated type with three high-potential and eight low-potential taps, the latter running from 300 down to 110 volts. At the latter pressure current is provided for heating, lighting and auxiliary purposes. The connection of primary and secondary transformer windings is virtually in series, as shown in Fig. 14, comprising an "auto-transformer." The high tension wiring of the car is done mainly with varnished cambric cable, drawn through loricated iron conduit. A small amount of high grade rubber cable is used, but it is thoroughly protected with varnished cambric tape wherever there is danger of a brush discharge to ground breaking down the insulation.

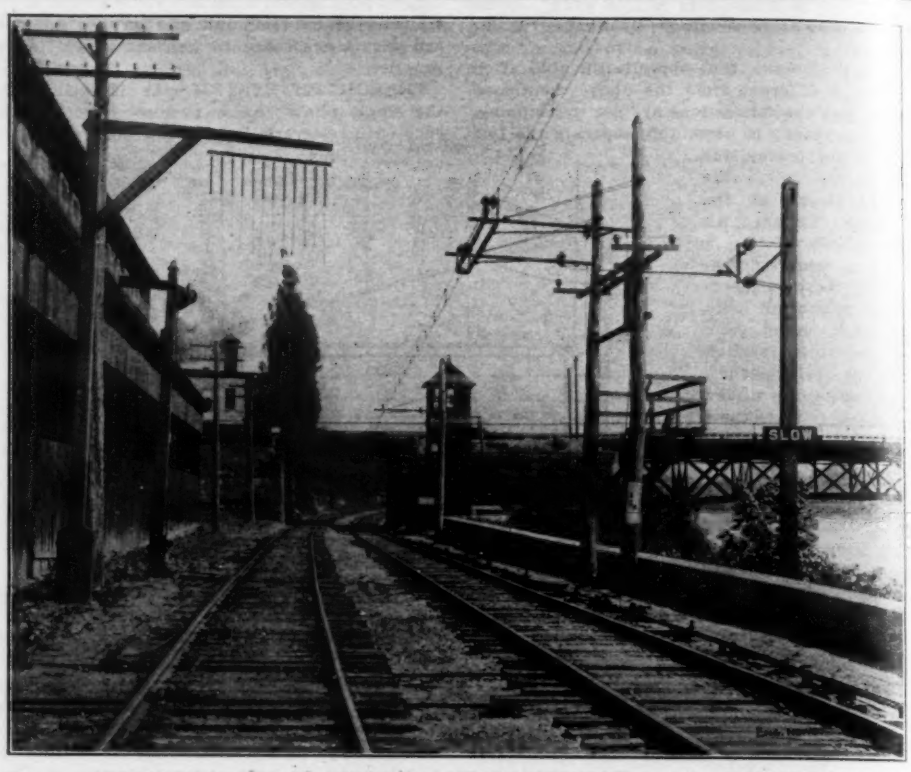


FIG. 9. APPROACH TO THE CLARISSA ST. BRIDGE, ROCHESTER, N. Y., SHOWING SECTION BREAK AND WARNING SIGNAL.

In the main low potential circuit are the switch group, the preventive coils and the reverser. The switch group is a set of air operated switches controlled by magnet valves, all mounted in one frame. It is placed athwart the car as near as possible to the low tension end of the main transformer. The switches of the group are all provided with interlocks, which automatically govern the connections in such a way that each switch of the group acts only when the current in the motors has reached a predetermined value, thus making acceleration automatic. Preventive coils are used across the terminals of some of the switches of the group, to prevent excessive current flowing at the instant of closing the switch. Each switch in the group is fitted with its own blow-out coil. There are two reverser switches actuated by air pressure, one for each pair of motors. Current from the main motor circuit is led through the motor limit switch, which makes effective the functions of the interlocks, on the switch group, and renders it impossible for the successive switches to be thrown in unless the limit switch is closed.

The control circuit includes a master controller, in each vestibule, the train line wires and their connections to the valve magnets and interlocks, a storage battery supplying current for these wires, and a motor generator set, which is used either to charge the batteries or to actuate the control system. The master controller makes the proper connections by means of which the 15-volt storage battery actuates the valve mag-

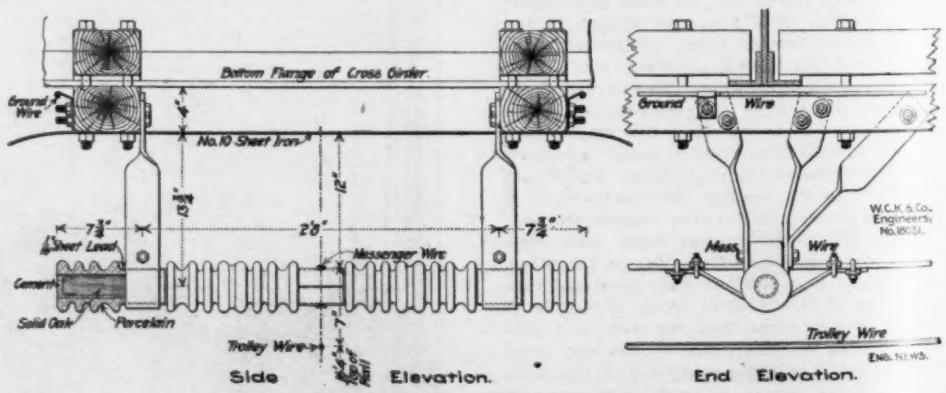


FIG. 10. LOW BRIDGE CATENARY CONSTRUCTION.

ne which control the action of the air operated m contactors in the switch group, and the re rsers. The controller handle is normally held in a vertical central position by springs unless it is moved to one of the running points by the motorman. When released from the grasp of the hand it flies to the vertical position, cutting off the power, and causing the emergency application of the brakes by means of a brake relay valve alongside of it. There are two holes in the face of the master controller, directly under the handle, and attached to the handle by means of a chain is a plug which may be inserted into either of these holes. The master controller is not operative unless this plug is pushed all the way into the lower hole, which closes the line switch, connects the generator and battery, and puts the brake relay valve into circuit. This is the ordinary running position of the plug. In case the line switch is opened by an overload, which generally causes the trolley to be lowered, the plug is taken out of the lower hole and placed in the upper, which action immediately closes the line switch, releases the trolley and allows it to spring up against the wire. As soon as the power is thereby returned to the main circuit, the plug is taken out of the upper hole and replaced in the lower one. There is a push button upon each side of the bottom of the master controller case. That on the right hand side is used for dropping the trolley and opening the line switch. When the button on the left hand side is pressed, the switch group is stepped up to the last or high speed notch and remains in that position until the handle of the controller has been returned to the off position.

There are four distinct notches on each side of the controller, the first corresponding to the coasting position, with the power off, the others enabling such gradations of speed as may be desired. Reversal is effected by moving the controller handle to the opposite side of the center or dead point.

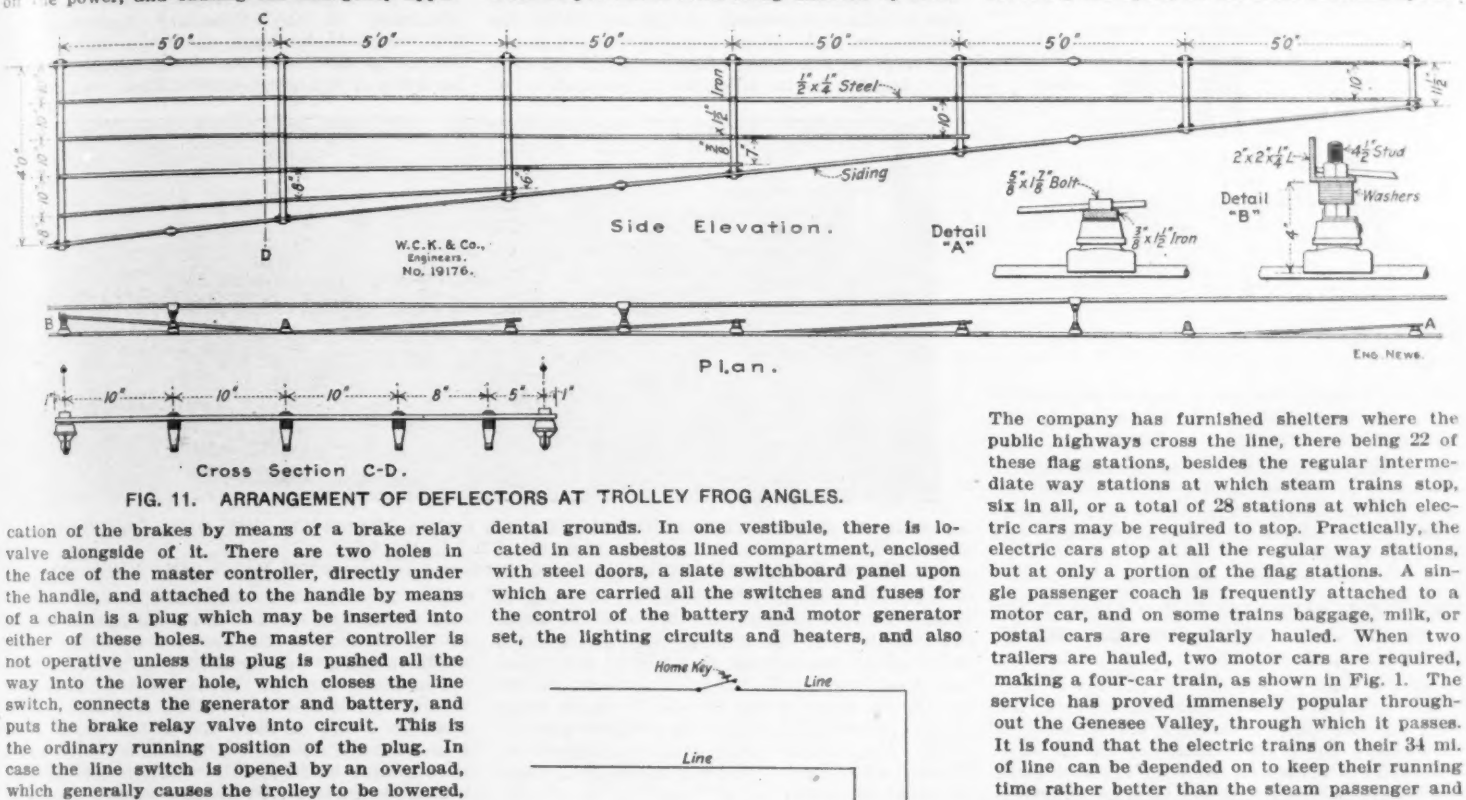


FIG. 11. ARRANGEMENT OF DEFLECTORS AT TROLLEY FROG ANGLES.

dental grounds. In one vestibule, there is located in an asbestos lined compartment, enclosed with steel doors, a slate switchboard panel upon which are carried all the switches and fuses for the control of the battery and motor generator set, the lighting circuits and heaters, and also

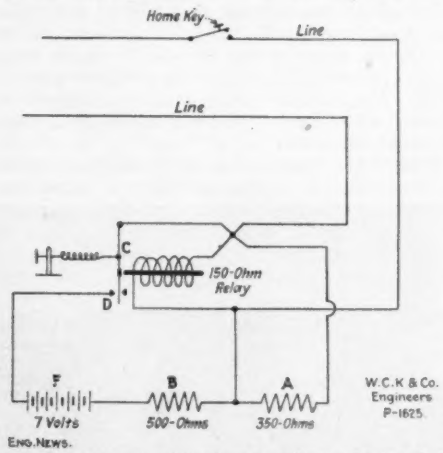


Fig. 12. Diagram of Applegate "Static Pickup" for Erie Telegraph Lines.

the main connection from the low tension side of the transformer to the auxiliaries. The control circuit consists of 12 wires which are connected from car to car by "jumper" cables in junction boxes or receptacles, at each of the four corners of the car under the end sills.

placed upon the car at the Buffalo shops of the Erie.

OPERATION.—The equipments above described were intended to be sufficient for operating single-car trains with one stop per mile over the entire road, at an average schedule speed of 24 mi. per hr. or to haul one trailer making stops about 2½ mi. apart, at the same schedule speed. The company has furnished shelters where the public highways cross the line, there being 22 of these flag stations, besides the regular intermediate way stations at which steam trains stop, six in all, or a total of 28 stations at which electric cars may be required to stop. Practically, the electric cars stop at all the regular way stations, but at only a portion of the flag stations. A single passenger coach is frequently attached to a motor car, and on some trains baggage, milk, or postal cars are regularly hauled. When two trailers are hauled, two motor cars are required, making a four-car train, as shown in Fig. 1. The service has proved immensely popular throughout the Genesee Valley, through which it passes. It is found that the electric trains on their 34 mi. of line can be depended on to keep their running time rather better than the steam passenger and freight trains, operating over the main line.

In addition to the facilities for repairs, afforded by the regular division shops at Avon, a brick car-inspection shed to accommodate four cars, has been built adjacent to the Avon substation. At the Rochester terminal a concrete inspection pit 60 ft. long is provided, on one of the side tracks close to the passenger station.

The single-phase system was recommended for the electrification of this division by the Electric Traction Commission of the Erie Railroad, and after authorization by the company, was installed under the general direction of Mr. J. M. Graham, Vice-President in charge of the construction department of the Erie. The engineering and the construction work, were carried out, and the system brought into operative condition by Westinghouse, Church, Kerr & Co., who designed and erected the buildings and the catenary trolley construction, bonded the track, and installed the electrical apparatus in the substation and on the cars. The adjustment of the telegraph system

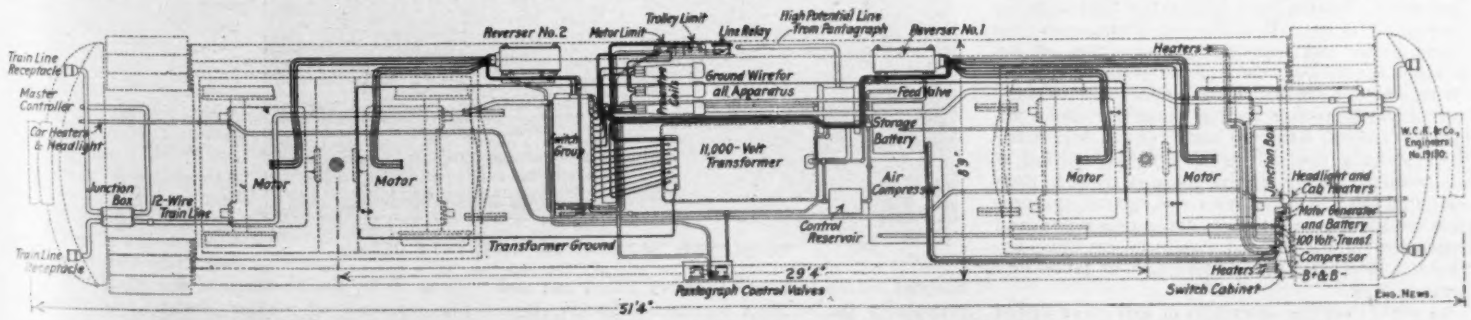


FIG. 13. DIAGRAM SHOWING ARRANGEMENT OF ELECTRICAL APPARATUS AND MAIN CIRCUITS OF MOTOR CARS, ERIE R. R.

The motor generator set is a compact machine of about 1/6 KW., the motor being of the self starting induction type, wound for 110 volts, the generator being normally of about 23 volts. It is placed under one of the seats in the car, and is covered by a box with removable lid, so that it can easily be reached for such small attention

The low tension wiring between the transformer and switch group, and motors, is all enclosed for protection in a boxing of "Transite" or asbestos lumber, as the inductive effects of heavy currents at low pressures rendered the use of iron conduit impossible for this part of the wiring. The electrical and air brake equipment was

was carried out jointly by the Western Union Telegraph Co. and the telegraph department of the railroad company.

The order was given to the engineers on June 6th, 1906, and although the intense activity in construction work all over the country at that time rendered it difficult to secure materials and

labor promptly, the work was pushed so rapidly that about 7½ months later, on Jan. 22, 1907, the first official trial trip was run between Avon and Rochester. The severe winter weather thereafter prevailing delayed the completion of the work until spring. During April and May, the whole equipment of substation apparatus, lines and cars was thoroughly tried out in a course of experimental operation, which also enabled the railroad employees to become familiar with the new system. On the 18th of June, commercial operation began, and has since continued permanently with marked success.

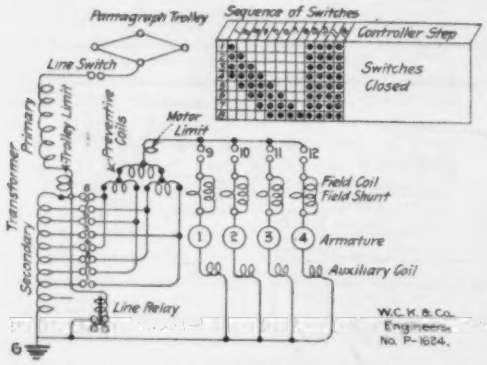


Fig. 14. Diagram Showing Scheme of Main Circuits and Controller Switch Operations 4-Motor Equipment, Single-Phase System.

STRUCTURAL MATERIALS TESTING LABORATORIES OF THE UNITED STATES GEOLOGICAL SURVEY, ST LOUIS, MISSOURI.

By HERBERT M. WILSON,* M. Am. Soc. C. E.

The attention of the engineering public has been strongly drawn through the columns of Engineering News in connection with the Quebec Bridge disaster, to the need of more exact knowledge as to the behavior of large structural members under full load conditions. Engineers are now questioning as never before the accuracy of the formulas employed in designing all large compression pieces, and it is evident that the existing doubt can only be removed through the knowledge to be derived from the actual test of such structural members.

Fortunately for those interested in structural works of concrete or reinforced concrete, the United States Government is now, through the medium of the Structural Materials Testing Laboratories of the Geological Survey, carrying on a series of tests upon these materials which should furnish to the engineering profession definite information as to the behavior of these materials when assembled into large pieces.

This work had its inception at the Louisiana Purchase Exposition in 1904 in the Collective Portland Cement Exhibit and Model Testing Laboratory of the Association of American Portland Cement Manufacturers, under the direction of Mr. Richard L. Humphrey. This exhibit was fortunately located near that of the United States Geological Survey Fuel-Testing Plant, and thus came under the immediate observation of Dr. Joseph A. Holmes, the present Chief of the Technologic Branch, under whom this and the Structural Materials Testing Plant are conducted. Doctor Holmes with the assistance of Mr. Humphrey, and a few of the more public spirited of the cement manufacturers, headed by Mr. Robert W. Lesley, evolved from this exhibit the project which has resulted in its continuation and extension into the most complete cement concrete, and reinforced concrete testing laboratory in existence.

In order that the operations of this plant should be carried on with a view to practical usefulness, the National Advisory Board on Fuels and Structural Materials was created by President Roosevelt, consisting of representatives from the various national engineering societies and Government engineering bureaus. The members of this board were selected from the men best qualified to advise in such matters, and represent the American Institute of Mining Engineers, the American Institute of Electrical Engineers, the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Society of Testing Materials, the American Institute of Architects, the National Fire Protective Association, the American Railway Engineering and Maintenance of Way Association, the National Association of Cement Users, the Association of American Portland Cement Manufacturers, and a dozen other technical societies. The board also includes, as representatives of the Federal Government, officers of the Corps of Engineers of the Army, of the Isthmian Canal Commission, the Director of the Reclamation Service, the Supervising Architect of the Treasury Department, the Chief of Ordnance of the Army, the Chief of the Bureau of Steam Engineering of the Navy, etc. This board was formally organized in 1906 with Dr. Charles B. Dudley as President, and Mr. Richard L. Humphrey as Secretary.

Prior to the organization of the National Board, a Joint Committee representing the engineering societies first named above, had been organized for the purpose of standardizing tests of concrete and reinforced concrete. The tentative program of the Joint Committee was revised and later adopted by the National Advisory Board and now constitutes the working outline of the investigations of structural materials which are being carried out by the Geological Survey.

The next annual meeting of the National Advisory Board for the purpose of reviewing work executed to date, and for considering the conduct of future investigations, will be held at the Jamestown Exposition at Norfolk, Virginia, October 25 and 26. These dates have been adopted by the Exposition officials as those upon which all those who are interested in fuels and structural materials should be encouraged to visit the Exposition.

The first meeting of the proposed American Peat Association has been called to be held there on October 24 and 25. The membership of this Association is to include the principal owners of peat properties, and the principal manufacturers of prepared peat and of peat machinery. The Chairman of the Voluntary Committee is Dr. Joseph Hyde Pratt, the State Geologist of North Carolina, and the Secretary, Mr. Julius Bordello, of Kingsbridge, New York. October 25 has been designated "Fuel and Cement Day," and a reception will be held upon that occasion in the building of the fuel and structural materials plant in the Exposition grounds.

FIG. 1. STRUCTURAL MATERIAL TESTING LABORATORIES OF THE U. S. GEOLOGICAL SURVEY, ST. LOUIS, MO.

(Part of the Concrete Exhibit at the Louisiana Purchase Exposition of 1904 appears in the foreground.)

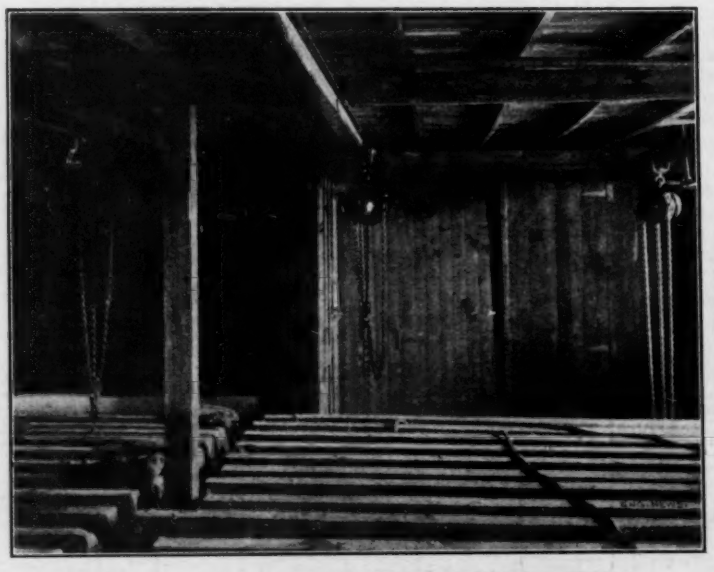


FIG. 2. SEASONING REINFORCED CONCRETE BEAMS.

The main plant of the structural materials testing laboratories at St. Louis is housed in six buildings. One of these is used for office purposes, another by the constituent materials section, another building, 60 x 100 ft., is used by the beam, permeability, shear and tension sections. Another building houses the building block and a portion of the constituent materials section, as well as the petrographic and photographic sections. In this building are 25 bins, each of one carload capacity, for storing sand, gravel, broken stone, cement, etc., and a workshop equipped with machinery, lathe, drill press, etc. Two smaller buildings are occupied by computing and drafting sections, and for supplementary office and editorial purposes.

The equipment is quite complete as to minor apparatus and includes among the larger machines one 600,000-pound motor-driven automatic, universal, four-screw testing machine capable of testing columns of 30 ft. lengths, and of making transverse tests of beams up to 24 ft. span, and of tensile specimens up to 25 ft. in length. There are four 200,000-lb. motor-driving, automatic, universal testing machines capable of making compression tests up to 4 ft. in length, and transverse tests up to 20 ft. span. There is one 100,000-lb. testing machine of similar design, one 40,000-lb. hydraulic, hand-driven compression machine, one 10,000-lb. screw machine, and a number of 2,000-lb. and smaller machines for cement briquette testing. There are also wire testing machines and appliances for otherwise calibrating and testing the metal used for reinforcement.

For mixing the concrete there is one 1-yd. and two ½-yd. cubical mixers with automatic charging hopper mounted on skids. There are numerous cast-iron molds for cylindrical and cu-

*Chief Engineer, Technologic Branch, U. S. Geological Survey.

bical pieces, and for reinforced beams, etc. The steel beam molds in use are six in number, with ninety interchangeable bottoms for beams 8 x 11 x 15 ft. There are five typical, hollow concrete-block machines in use, which were selected by a committee of the Concrete Block Machine Manufacturers Association. In addition there are all necessary permeability, accelerated test, storage tank, and other apparatus.

The program for investigations which has been in progress at these laboratories during the past two years, includes the following primary inquiries:

1. Examination and classification of concrete materials of the United States, which involves a field survey of such materials, including sand, gravel and stone deposits, collection of samples, physical tests and chemical analyses of these at the laboratories, with a view to determining the availability of constituent materials in all parts of the country.
2. Tests and classification of mortars made with typical Portland cement and sand gravel, and one-fourth inch screen stone. These tests include specific gravity, fineness, time of setting, tensile strength, constancy of volume, and a complete series for physical tests on specimens seasoned for 7, 28, 90 and 180 days, and one year.
3. Tests and classification of concrete with the typical aggregate above specified, including physical tests on specimens seasoned for 30, 90 and 180 days, and one year. Tests for method of water proofing, protection against corrosion of metal, fire resisting qualities, freezing tests, salt water tests, etc., etc. This series of tests includes full-sized tests on beams of various spans, sections, and composition, and building blocks and bricks.
4. Tests of reinforced concrete in full-sized beams and columns for effect and amount of reinforcement, of character of reinforcement, of form, size and position of reinforcing bars, the initial strength of reinforcement, of different manners of reinforcement, and of a number of other variations in such tests. Also tests of reinforced slabs and of reinforced arches, the former supported at two or four edges or with expanded metal wire mesh, etc., the latter of continuous ring, hinge, voussoirs, etc.

It is evident that this program of investigations will require a number of years to carry to completion. Meantime, as the investigations are passing progressively through the testing of the larger pieces, additional testing machines are being procured. There has already been purchased and there is about to be put in operation a new testing machine for compression tests of capacity of 1,200,000 pounds, and capable of testing vertical columns up to 40 ft. in height, and plans are being perfected for the construc-

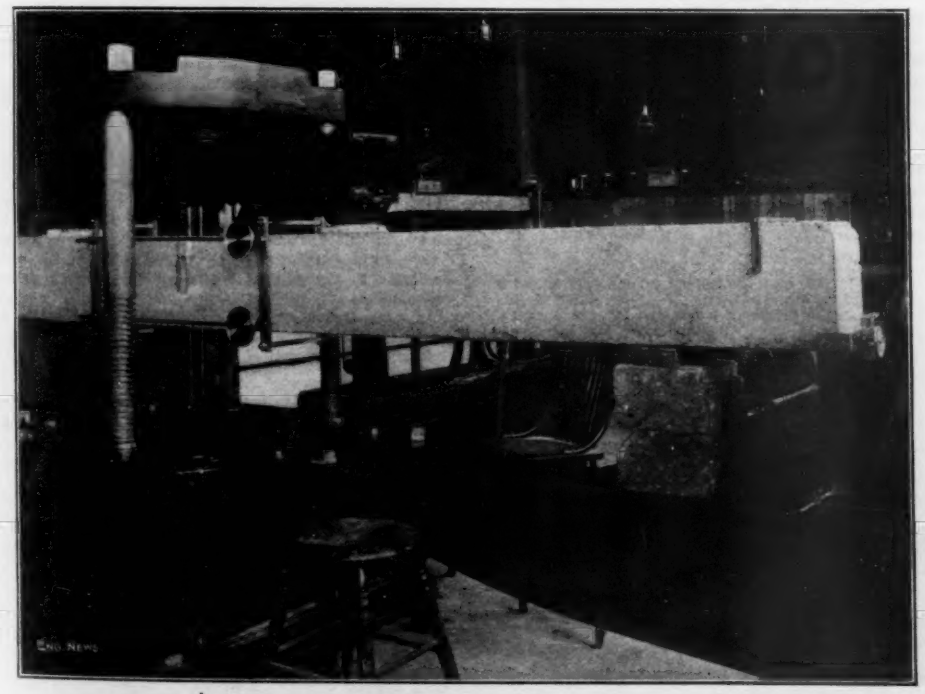


FIG. 3. TESTING A REINFORCED CONCRETE BEAM.

tion of a compression machine of 5,000,000-lb. capacity.

The results of the operations of these testing laboratories have been apparently slow in reaching the public for the reason that before actual tests could be commenced after the equipment of the laboratories, practically a year had to elapse in order that the test pieces might have time to season in sufficient quantities, for the full period.

A report of the results of the first full year of testing has just been submitted to the public printer at Washington by Mr. Richard L. Humphrey, the Engineer-in-Charge, and includes an outline of the organization, equipment, and operations of the plant. A second report has also been completed which deals with the results of 25,000 tests of the constituent materials of Portland cement mortars. It is evident that this report covers the most extended series of such tests ever attempted. Altogether over 35,000 tests have been made of sands, gravel, and stone screenings, and will be reported in additional bulletins dealing with investigations of these materials as mortars, and as concrete. Other bulletins in course of preparation will deal with reinforced beams, with concrete and reinforced concrete columns, and with the same materials in floor slabs, etc. The bulletin now in press which gives the results of 25,000 tests covers such tests on 22 sands, 12 gravels, and 25 stone screenings, in the form of mortar used in different proportions and coming from different localities throughout the United States.

A NEW DESIGN OF BALANCED GATE-VALVE.

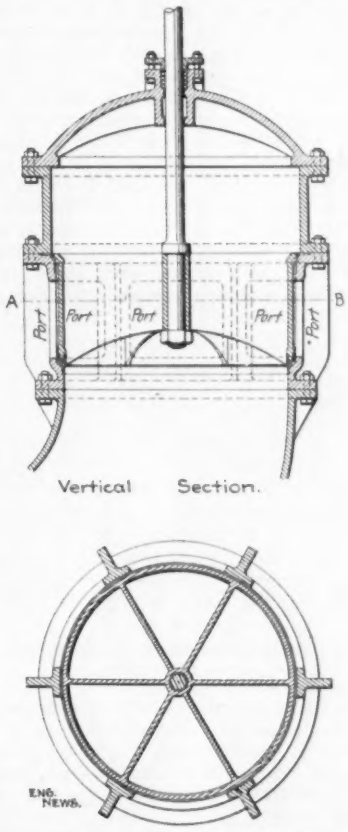
The accompanying drawing illustrates a double-seated, balanced gate-valve of new design, possessing features of advantage over the ordinary sluice-gate or disk valve.

In Engineering News for Oct. 4, 1906,* is a description of a cylindrical balanced valve with one conical seat, three of which were installed in Gatehouse No. 2 at the new Croton Dam. Mr. John Peterson,† Assoc. M. Am. Soc. C. E., who designed that valve, also designed and patented the valve here illustrated.

From a reference to the drawing on p. 346 of that issue, it will be seen that above the inflow ports in the valve of earlier design there is a clearance between the rings of composition metal on the plug and the metal on the inside of the cylindrical casing. Mr. Peterson states that this clearance is about 1/16-in., and that there is, through the annular space thereby provided, a constant small leakage, which runs off through the by-passes with which the valves on the down-stream side of the dam are provided.

The function of the upper conical seat, in the valve shown here, is to obviate such leakage. The seats being situated above and below the inflow ports, pressure on the plug is thereby balanced and the plug is raised with much less exertion than is necessary with a single-seated valve.

Such a valve is obviously more readily operated than an ordinary disk or sluice-gate valve. It may be adapted to either a vertical or a horizontal position, and may be installed in a pipe-line with the use of special castings; in the latter case an elbow will be necessary, with a corresponding small offset in the line at the point of installation.



Vertical Section.

Horizontal Section A-B.

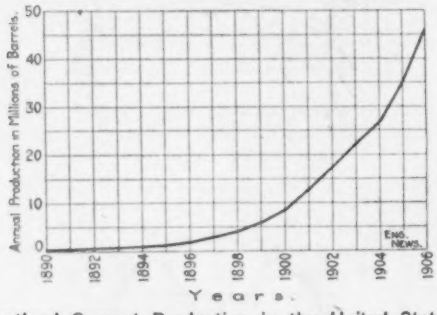
New Type of Balanced Gate Valve.

*Pp. 345 and 346.
†Room 1019, 299 Broadway, New York City.

SYSTEMATIC FORESTRY WORK IN MASSACHUSETTS is provided for by recent legislation. This includes the creation of the office of State Forester, at a salary of $3,000 a year, who is an ex-officio member of the State Board of Agriculture; also mandatory legislation providing for town and city forest wardens. It is the duty of the State Forester "to promote the perpetuation, extension and proper management of the forest lands of the Commonwealth, both public and private," and to give instruction in forestry at the Massachusetts Agricultural College (Amhert, Mass.). He is authorized to give, on request, advice on forestry management to private owners of forest lands, provided his "necessary expenses of travel and subsistence" are paid by the recipient. He is also empowered to establish a nursery for forest seedlings on the college grounds of the Massachusetts Agricultural College at Amherst. Seedlings from such a nursery are to be supplied to the Commonwealth without charge for use upon "reservations set aside for the propagation of forest growth for other than park purposes." Citizen-landowners may be supplied with seeds and seedlings under such conditions as the forester, subject to the approval of the Governor and Council, may establish. The forest wardens to be appointed by cities and towns are subject to approval by the State Forester. These wardens must take measures to prevent forest fires and must fight such fires as occur. They must also investigate the cause, extent and injury done by forest fires, the value and character of forest lands, the character and extent of wood-cutting operations, and the prevalence of insects injurious to forest growths. Mr. F. W. Rane, 7 State House, Boston, Mass., is the first State Forester appointed under this new legislation, and has issued several handy pamphlets bearing on forestry, including one embracing Massachusetts legislation on forestry and associated subjects. It may be added that any town or city in Massachusetts may take or buy land, or accept gifts of money or land for "a public domain," to be "devoted to the culture of forest trees, or to the preservation" of its water supply, but the title to any such land "shall rest in the Commonwealth for the benefit of the city or town in which it lies."

CEMENT PRODUCTION IN THE UNITED STATES.

The production of cement in the United States is still increasing at even a higher rate than ever before, according to the regular annual report issued by the U. S. Geological Survey, under the direction of Mr. Edwin C. Eckel, Assoc. M. Am. Soc. C. E. The remarkable development of the concrete industry has been exploited to so great an extent that any new reference to it seems trite, but the figures collected by the government emphasize the immense amount of cement now used in this country and what is more noteworthy, the ever increasing rate of increase in that use. In 1887 the total Portland cement output in this country was 250,000 bbls., with about 6,900,000 bbls. of natural cement; in 1906 the Portland cement production was over 46,000,000 bbls., the natural only about 4,000,000 bbls. These figures, together with the accompanying curve and the table, will show what an enormous industry is being built up in Portland cement manufacture, for the natural cement production, which for years ran along at about 6,000,000 bbls. per year, is now slowly dropping away.



Portland Cement Production in the United States from 1890-1906.

A study of the curve will show that from 1890 to 1895 the manufacture of Portland cement was at a standstill, from 1895 to 1900 it increased at a normal but slightly increasing rate, probably no more, however, than any of the other large materials of construction. In 1900 the rate of increase took a jump but remained about equal through the three years, 1901-1903. From 1904 to the present, the rate has been getting higher and higher, until it must be largely in excess of that of any other building material. As Mr. Eckel notes in the report, this increasing rate is the characteristic of a new industry which has not as yet found its level and is not affected by any of the fluctuating conditions of outside trade. At present the cement industry is in as prosperous condition as can be desired, but it is improbable that the high rate of increase can be maintained. The continuation of the curve shown would give about 60,000,000 bbls. for 1907 and 75,000,000 bbls. for 1908.

In this connection it is interesting to compare the official figures with a compilation of some data given in the recently published Directory of Portland Cement manufacturers of the United States for 1907. This directory lists all of the cement plants in this country now working, with their officers, capitalization and nominal production, together with all plants projected and their proposed production. The nominal production of a plant is presumably determined from its daily capacity multiplied by the working days in the year and necessarily is largely in excess of the actual production, as no allowance is made for breakdowns or other certain causes of delay. The directory gives 82 working plants in 1907, with a nominal production of 81,000,000 bbls. per year, and 84 more or less tentative plants, with a proposed annual production of 30,000,000 bbls. Applying the same reduction for loss of time, etc., to the proposed plants, will give a production in 1908 of between 75,000,000 and 80,000,000 bbls. This, it will be noticed, agrees with the figures estimated from the curve. In case of any business depression within the next year, these values are, of course, high.

It is worthy of notice that all of this cement is being used in this country, the small amount of exports being less than the amount of imports, which latter this year have risen somewhat on account of the great amount of cement used in San Francisco, which could be transported from Europe, through the Suez Canal, at cheaper rates and on shorter notice than from the eastern states. The following figures show the total consumption of Portland, natural and puzzolan cement in the United States in 1906:

	Bbls.
Total production in U. S.	51,000,445
Imports withdrawn for consumption	2,274,677
Total	53,275,122
Exports	583,299
Total consumption	52,691,823

Other interesting data in the report show the geographical distribution of the cement plants in this country. Two counties in Pennsylvania, Lehigh and Northampton, produced in 1906 39.5% of all the cement in the United States; the rest of Pennsylvania, New York and New Jersey produced 15.4%, the central states east of the Mississippi, together with Missouri, produced 30.2%, California and Washington, 2.8%, the rest of the western states, 8.2%, and the southern states, 3.9%. There are no cement plants in New England.

UNIFORM SYMBOLS FOR WIRING PLANS.

At the sixth annual convention of the National Electrical Contractors' Association in 1906 a set of symbols, recommended for all wiring plans, was adopted. It will be remembered that this set of symbols was the work of a committee appointed the year before and that this committee obtained the opinions and ideas of the most prominent engineers and architects, universities, technical journals and of several government departments.

A new edition of this set of standard symbols has very recently been issued by the National Electrical Contractors' Association, and as this edition presents a few changes from the former arrangement as published (see Engineering News of Oct. 11, 1906), it has been found advisable to reprint the changed symbols, together with the new form. A few additional suggestions have been incorporated with the new edition of the table. These are as follows:

Changed to

Ceiling Oulet: Combination. 4/2 indicates four 16-c. p. standard incandescent lamps and two gas burners.

If gas only.

Changed to

Bracket Outlet: Combination. 4/2 indicates four 16-c. p. standard incandescent lamps and two gas burners.

If gas only.

S
Changed to
S'
S. P. switch outlet.

Changes in Standard Symbols for Wiring Plans.

Heights of center of wall outlets (unless otherwise specified):

Living rooms	5 ft. 6 ins.
Chambers	5 ft.
Offices	6 ft.
Corridors	6 ft. 3 ins.

Height of switches (unless otherwise specified), 4 ft.

TABLE SHOWING CEMENT PRODUCTION IN THE UNITED STATES, 1904-1906.

	Portland		Natural		Puzzolan		Total	
	Bbls.	Value.	Bbls.	Value.	Bbls.	Value.	Bbls.	Value.
1906	46,463,424	$52,466,186	4,055,797	$2,423,170	481,224	$412,921	51,000,445	$55,302,277
1905	35,246,812	$33,245,867	4,473,049	$2,413,052	382,447	$272,614	40,102,308	$35,931,533
1904	26,505,881	$23,355,119	4,896,331	$2,450,150	303,045	$226,651	31,675,257	$26,031,920

THE TIME OF PASSAGE OF LIQUID THROUGH PERCOLATING BEDS.*

By WILLIAM CLIFFORD,† Assoc. M. Inst. C. E.

The time taken by liquid to pass through percolating beds has been variously stated from two to eight or more minutes; generally it is referred to as "occupying a few minutes," or as "the rapid passage of liquid through the bed." The method of determining this time appears to have been simply to pour a quantity of colored liquid on the surface of the bed while in action, and note the time between the pouring of the liquid and the first appearance of color at the outlet. By this method the time of passage of a comparatively small portion of the dose or added liquid is measured. It takes no account of the bulk of colored liquid poured over the surface. Now, there appears to be no reason why the first trace of a given dose appearing at the outlet should be taken to indicate the time of passage of that dose, any more than the last trace. It will, therefore, be necessary to define what is meant by the time of passage of liquid through a bed. The time of passage of any portion of liquid may be defined as the average time of passage of all the molecules of that portion of liquid. For practical purposes, it will be sufficient to find the general distribution of the observed liquid in the effluent, and from this to calculate the mean distribution; this gives the average time. The following experiment will illustrate the method of determining the average time. A solution of common salt was used for observation, instead of a colored liquid. An 18-in. earthenware pipe, filled with clean, washed and screened gravel, which passed a 1-in. and remained on a ¾-in. mesh riddle, formed a circular bed 18 ins. diameter and 2.4 ft deep. A tipping trough, arranged above, emptied its contents into a perforated tray, which distributed the water over the medium. Tap water was used, instead of sewage or tank effluent, in order to obviate the disturbing action of the organic matter, and a variable chlorine content. The water was obtained from an elevated tank which gave a constant head. In this particular experiment, the flow of water into the tipping trough was 124 c.c. per min. (equal to 240 [U. S.] gals. per sq. yd. per day). The trough held 465 c.c. before tipping, and, therefore, an intermittent dose of this amount was poured into the tray and distributed over the medium every 3¾ minutes. Each distribution or sprinkle lasted 5 seconds. After a few doses the amount of water leaving the bed in intervals of distribution became equal to that distributed over the surface. When the bed had been in action for one hour, the water flowing into the tipping trough was intercepted, and received into a graduated cylinder. This took place immediately after a turn of the trough. The now empty trough, instead of receiving water, was filled with a solution of common salt, of known chlorine content, and held from tipping until an equal quantity (i. e., 465 c.c.) of the inflowing water was collected in the cylinder. At this point the trough was turned, the chloride solution distributed over the medium, and the flow of water into the trough continued as before. Samples of the effluent were then taken, every fifth minute. In the earlier experiments samples were taken every minute, but a sample taken every fifth minute was found to give a result sufficiently accurate for all practical purposes. The combined chlorine in the samples (shown in the second column of the following table) gives the distribution of the chloride in the effluent. The average time of passage is obtained by calculating by the method of moments the mean frequency of the combined chlorine, after first reducing the amount by that present in the water previous to the addition of the solution; it is given by

$$\frac{\Sigma\, P.Q}{\Sigma\, Q},$$

where P is the minute corresponding to the combined chlorine Q.

Time. (P.)	Combined chlorine in sample, parts per 100,000.	Combined chlorine, less 3.8. (Q.)	Product of $P.Q$.
Previous ...	3.8	...	....
5th minute	11.6	7.8	39.0
10th minute	20.5	16.7	167.0
15th minute	16.2	12.4	187.0
20th minute	11.2	7.4	148.0
25th minute	8.6	4.8	120.0
30th minute	7.0	3.2	96.0
35th minute	6.1	2.3	80.5
40th minute	5.2	1.4	56.0
45th minute	4.8	1.0	45.0
50th minute	4.4	.6	30.0
55th minute	4.3	.5	27.5
60th minute	4.1	.3	18.0
65th minute	4.0	.2	13.0
70th minute	3.9	.1	7.0
		58.7	1033.0

Whence the average time, $\frac{\Sigma\, P.Q}{\Sigma\, Q}$, is 17.6 minutes. This result is obtained with clean, coarse gravel, and a distribution of 240 [U. S.] gals. per sq. yd. per day.

*A paper read at Manchester, England, May 3, 1907. Reprinted from Jour. Soc. of Chem. Industry, July 15, 1907; No. 13, Vol. XXVI.

†Wolverhampton Sewage Works, Wolverhampton, England; formerly of the Manchester Sewage Works.

The accompanying table shows the results obtained with various grades of medium and rates of sprinkling, the depth in each case being 2.4 ft.

A word of explanation may be permitted with regard to the seemingly long time of passage. In the first place, the idea of mere trickling requires to be eliminated. A bed, even when draining, retains a considerable amount of water; now, suppose for the moment there are 9.6 [U. S.] gals. of water in each cubic yard of medium, exclusive of that in the pores of the medium, then a perfect distribution of 9.6 gals. (230 [U. S.] gals. per sq. yd. per day) would be only sufficient to change the water once an hour, assuming simple displacement. The displacement is really accompanied by a very considerable amount of mixing.

TIME OF PASSAGE THROUGH VARIOUS GRADES OF SEWAGE SPRINKLING FILTERS MATERIALS.

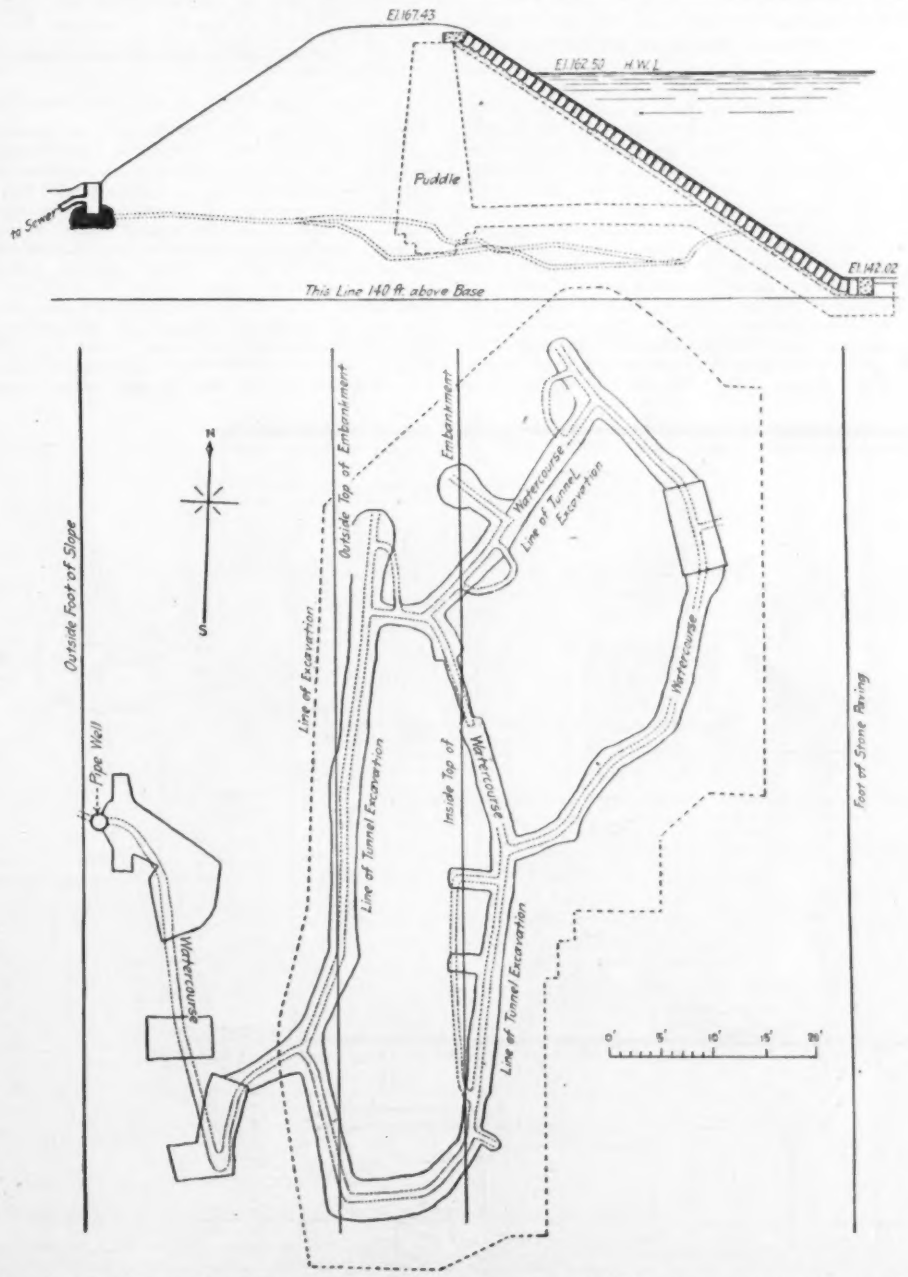
Medium.	Grade, ins.	Rate of working, gals. per sq. yds. per day. Imp.	U. S.	Average time of passage, minutes.
	¾ — ⅝	239	287	24.3
		180	216	31.7
		105	126	45.6
Coal	½ — ⅜	307	368	26.4
		134	160	49.4
	⅜ — ¼	228	278	34.0
		191	229	39.0
		129	155	63.6
	¼ — ⅛	236	285	54.7
		181	216	64.3
	1 — ¾	245	294	15.0
		200	240	17.6
		154	185	22.0
Gravel	¾ — ⅝	259	312	20.1
		194	234	31.5
		137		35.8
	⅝ — ½	250	164	31.2
		192	230	37.2
		166	199	40.0
	½ — ¼	246	295	33.7
		197	236	40.0
		155	196	44.1

In conclusion I wish to thank my assistant, Mr. Harold Wilson, for help in sampling and in the chlorine determinations.

REPAIRING A REMARKABLE LEAK IN A RESERVOIR EMBANKMENT AT PROVIDENCE, R. I.

One of the most unique pieces of repair work in the history of public water supplies is briefly described by Mr. Otis F. Clapp, M. Am. Soc. C. E., City Engineer of Providence, in his report for the year 1906. In May, 1906, the reservoir then being empty for purposes of cleaning, it was decided to discover the source of a leak in the reservoir that had been in existence for more than 25 years. The work is so tersely and interestingly described by Mr. Clapp that we cannot do better than to quote from his report and to reproduce an accompanying illustration, as follows:

The water appeared at the foot of the bank on the west or Brown St. side of the reservoir, and had been taken into a pipe well, from which it was discharged into the Brown St. sewer. Measurements had been kept of the discharge for many years. Within two or three years the amount had increased somewhat, but not enough to cause alarm. Examinations had been made before, and considerable time and money had been expended, without finding any clew as to the location of the point on the inside of the bank where the water escaped. It was thought that the best way to trace the course of the water would be to follow the stream back into the bank. When the water had been drawn down so that there was a head of about 1 ft. on the discharge, digging was commenced. Almost immediately a water channel was found, measuring from 2 to 4 ins. high and from 4 to 8 ins. in width, and nearly level. This was followed some 54 ft. in open trench, and then tunneling was commenced. When a point was reached about under the outer top edge of the embankment, the channel divided, and ran in nearly opposite directions. In the belief that we could save time we then tried the experiment of forcing a lot of colored water back into the reservoir by way of each of these two routes, and were much surprised to have the color appear at the same point on the surface of the water in the reservoir. The reservoir was then emptied and cleaned and the tunneling was continued by way of both branches. The stone slope wall was taken down where the colored water had appeared and a hole was found several inches in diameter, which went back into the bank for several feet, where it branched and ran in opposite directions. The tunneling was prosecuted until the lines met, every effort being made to discover any side openings that might lead away, but only a few were found and those followed to the end. The material of the embankment was found to be hard and in the best of condition, only a few soft places were found, and those, all near the water course, were completely removed. The tunnel averaged about 4 ft. high and 2½ ft. wide, just large enough for a man to work in. This tunnel was surveyed and platted, a copy of which is here inserted. The tunnel measured 251 lin. ft., with 54 ft. of open cut. There were discovered 359 lin. ft. of water course in embankment. It was not thought safe to refill the tunnel, and so that portion of the bank lying over the tunnel excavation was taken out and the embankment rebuilt. This area is shown surrounded by heavy dotted line on plan. The water channel was found to have been about on the surface of the original soil, or where the artificial work in building the embankment was begun.



WATER COURSE THROUGH THE EMBANKMENT OF THE MOUNT HOPE RESERVOIR, PROVIDENCE, R. I.

In repairing, the precaution was taken to go down lower in the line of the core wall, finding rock from 2 to 5 ft. below where the embankment had been started before, and filling in with cement concrete. The excavation was then refilled with great care, some three carloads of Barrington clay being added to the soil taken out before replacing.

The work of repairing took about 3½ months to perform, and no sign of any leak has since appeared at this point. Mr. Samuel M. Gray, C. E., who was resident engineer at the time the reservoir was built, was consulted in relation to the repairs. A smaller leak or spring, coexistent with the other leak, is still discharging near the corner of the reservoir, and will be examined later.

SCRAPING WATER MAINS at Halifax, N. S., is briefly reviewed in a report recently submitted to the city by Mr. Willis Chipman, M. Am. Soc. C. E., of Toronto, Ont. This section of the report may be quoted as follows:

In 1880 a 12-in. mechanical scraper for removing incrustations from the interior of water mains was imported from Scotland, and in the following year the 15-in. and the 24-in. conduits were scraped, with the result that the average pressure was increased by nearly 20 lbs. at the fire hydrants, but the higher pressure increased the leakage, and the incrustations commenced again immediately.

For several years past, the 15-in. conduit has been scraped in May, September and November, and the 24-in. in November.

From 1881 to 1904 about 223 miles of pipes have been scraped at a cost of only $8 per mile. Before being scraped for the first time, 12-in. mains were found reduced to a diameter of 10 ins., and 4-in. mains to 2 ins.

A chemical analysis of the materials removed from the mains by scraping, gave the following results:

"We have made a careful analysis of the sample of powder received from you, and report as follows:

ANALYSIS OF INCRUSTATION.

	Per cent.
Oxide of iron (ferric oxide)	75.50
Oxide of iron (ferrous oxide)	0.90
Oxide of alumina (Al_2O_3)	2.48
Rock matter	1.92
Lime (CaO)	0.48
Magnesia (MgO)	0.63
Sulphuric Anhydride (SO_3)	0.23
Moisture at 212° F.	7.32
Organic matter by ignition	10.38
Difference	0.16
	100.00

NEW DYNAMOMETER CAR FOR THE PENNSYLVANIA RAILROAD.*

The dynamometer car for measuring train resistances recently completed by the Pennsylvania R. R., is the fifth car for this purpose which has been built by that road since the early sixties when the first car, equipped with a weighing device not unlike the ordinary butcher's balance, was put into service. Each of these cars has marked a great advance over its predecessor and the present one, with a measuring capacity of 100,000 lbs. or three and one-half times as much as the one next preceding, which was built in 1885, marks the latest development in dynamometer car practice.

The following description of the car is taken from information furnished by the railway company:

Except for the fact that it is a trifle shorter, has but one platform, and that its trucks are of rather unusual design, this car (Fig. 1) closely resembles the standard passenger coach. The under frame consists of a center sill of box section 38 ins. wide by 21 ins. deep, extending the entire length of the car, its form being modified, when necessary, to accommodate such portions of the mechanism as are placed within it. This construction not only affords a structure of unusual strength but also serves as a housing for the apparatus placed inside, access to which is gained through a series of trap doors in the floor of the car. The car body is supported by body bolsters and a series of lateral struts made of structural material, and firmly riveted to the side walls of the main girder. The ends of the struts and body bolsters are secured to 5-in. Z-bar side sills running the entire length of the car body on either side, and supporting the timber framing of the car.

The trucks are of the pedestal type specially designed to accommodate the deep center sill. Journal boxes, pedestal jaws and side frames are of cast steel, the latter being rigidly secured to the pressed steel truck bolsters. An 8-ft. wheel base is secured, and 33-in. steel-tired wheels with 5½ × 10-in. journals are provided.

Air brakes of the usual form supplemented by hand brakes are applied to all wheels except for the forward pair on the rear truck, from which pair the paper mechanism is driven. The draft mechanism at the rear or platform end of the car consists of a standard tender coupler in connection with a Westinghouse friction draft gear.

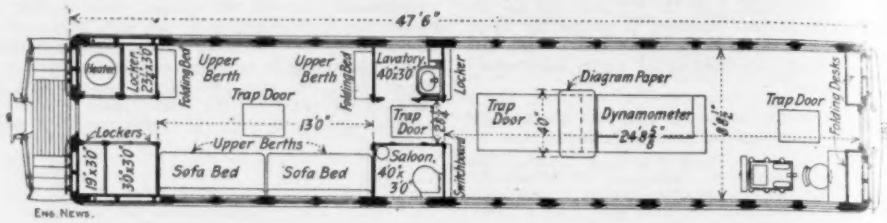
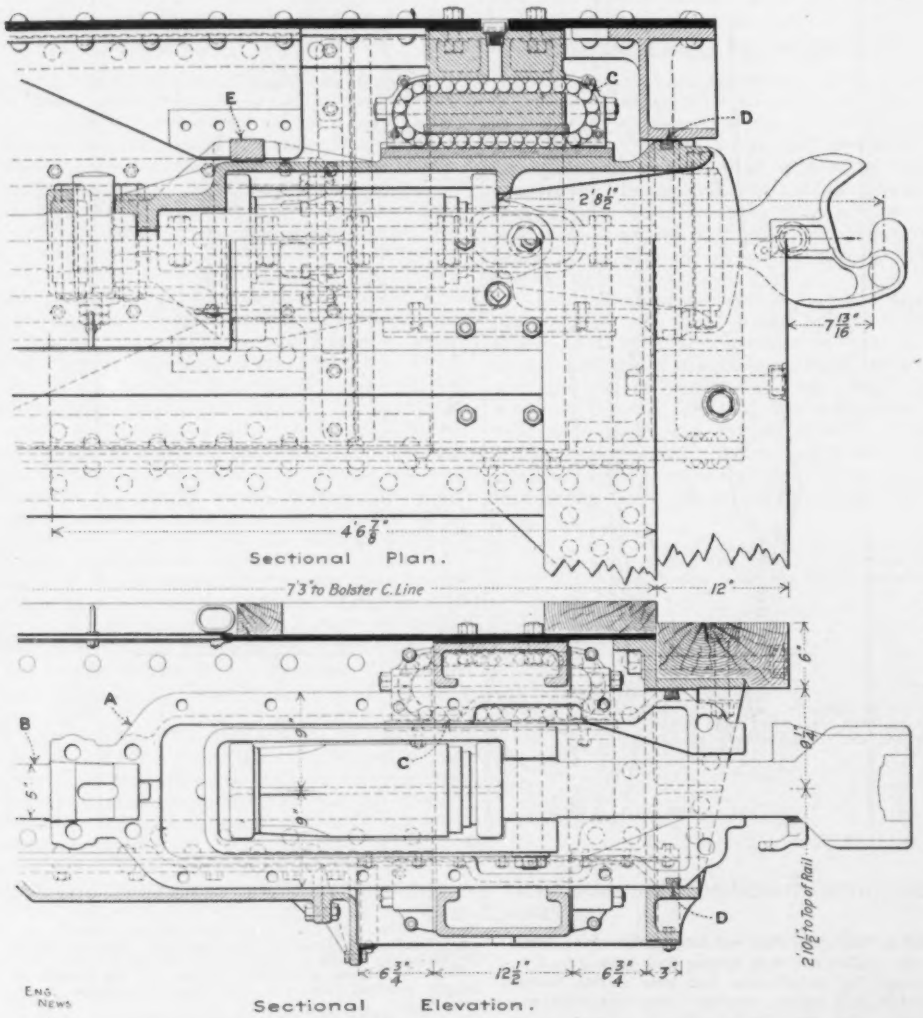


FIG. 1. GENERAL PLAN OF NEW DYNAMOMETER CAR FOR PENNSYLVANIA RAILROAD.

The interior of the car is divided into two main compartment (Fig. 1); the dynamometer compartment at the forward end, and the computing compartment at the rear. The former contains in addition to the weighing and recording apparatus, a generating set-car switchboard, tool cabinets, and two folding desks. A lookout window, permitting the observer to see the track ahead, can be adjusted to any one of four windows, depending on the direction of motion of the car and the side from which it is preferred to make the observations. The rear or computing apartment is equipped with a table and chairs; also four upper berths, two folding beds and two convertible sofas, which furnish sleeping accommodations for the crew of eight persons when a hotel is not available. An oil bath for storing the weighing springs when not in use, lavatory, saloon, heater compartment and lockers for fuel, oil and tools complete the equipment. The weight of the entire car is about 62 tons.



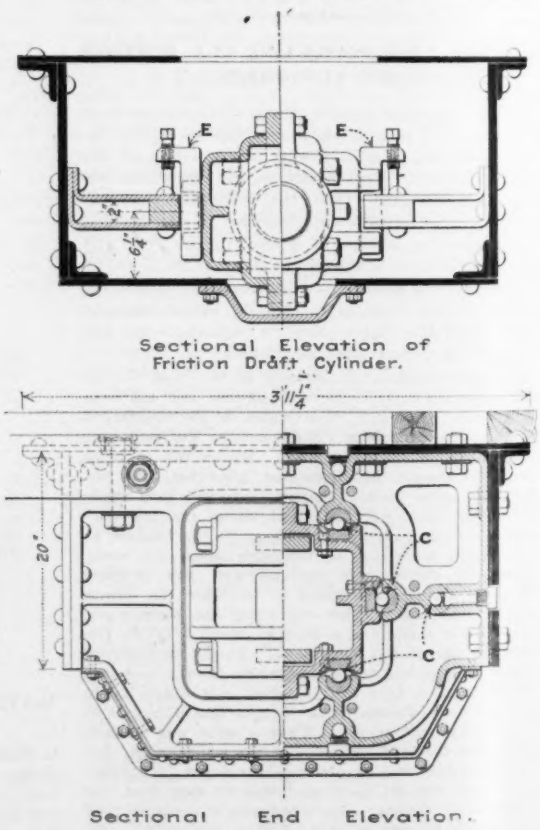


FIG. 2. DRAFT RIGGING AT DYNAMOMETER END OF PENNSYLVANIA RAILROAD'S NEW DYNAMOMETER CAR.

WORKING MECHANISM.

Briefly, the operation of the dynamometer car is as follows: A thrust or pull upon the coupler is transmitted through the drawbar to the piston of a hydraulic cylinder situated within the center sill about the middle of the car. Pressure in the main cylinder is transmitted to a smaller recording cylinder within the car, by means of oil with which both cylinders and connecting pipes are filled. Movement of the piston in the recording cylinder is resisted by calibrated helical springs, the deflection of which (and resulting movement of the piston) is proportional to the load on the coupler. A pen actuated by the piston rod of the recording cylinder, marks upon an endless strip of paper which moves beneath it, an irregular line, whose distance from the datum line is proportional to the load upon the coupler.

The coupler and friction draft gear (Fig. 2) are connected by the usual yoke and both secured within the heavy cast steel housing A to which the main drawbar B is attached. The housing is guided in the frame of the car by a set of six circuitous ball bearings C parallel to the line of draft, each containing 32 hardened steel balls 1¼-in. in diameter. Two of these bearings are below, two above, and one on either side, each having ten balls constantly in contact with the housing, thus holding it in rigid alinement without binding. To prevent dust and dirt from getting into the ball races from the outside, a felt bushing D is placed in the space between the gear housing and the end casting of the car frame. To relieve the dynamometer mechanism from all load when not in use, provision is made for securely locking the housing A to the frame of the car, by inserting a pair of tapered keys E into notches in housing A which, when there is no load on the drawbar, stand opposite corresponding notches in two brackets secured to the frame of the car.

About six feet back of the housing A the drawbar passes through a cast steel partition F (Fig. 3) and is connected to the buffer G composed of a nest of 36 helical springs, compressed and held at an initial load of 100,000 lbs. The function of the buffer is to protect the dynamometer apparatus from injury in case of loads or shocks of any kind in excess of 100,000 lbs., the normal capacity of the car.

MAIN HYDRAULIC CYLINDER.—At a point 20 ins. back of the buffer, the drawbar connects with the piston

*See Engineering News, June 6, 1907, p. 615, for description of new dynamometer car in use by International Correspondence Schools.

rod of the main hydraulic cylinder by means of a coupling (Fig. 4). The piston rod on either side of the piston is fitted to the glands with the utmost possible accuracy to allow of its working without packing and at the same time without friction. The piston, 16¾ ins. in diameter by 3 ins. long, is accurately fitted to the cylinder and grooved upon its periphery to secure lubrication and avoid the use of packing. The main hydraulic cylinder is made of gun iron in two parts, "32" and "33" (Figs. 3-4), and its interior surfaces are carefully ground to size to receive both the piston and the bronze glands for the piston rod. The cylinder, as a whole is contained in a heavy cast-steel yoke "31," which in turn is firmly bolted to the side walls of the center sill of the car by taper bolts shown at "92."

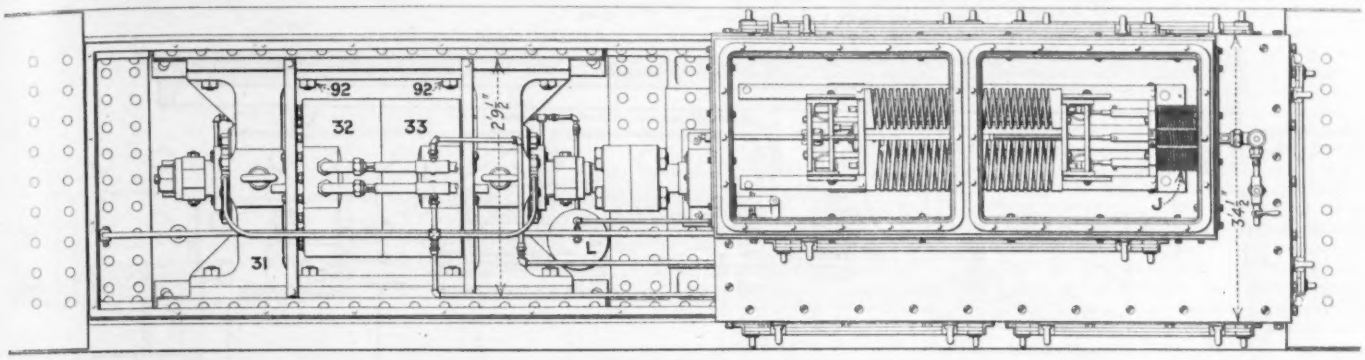
The draft mechanism from the inside face of the coupler to the center line of the piston is 21 ft. 10 ins. long. A series of ball, roller and rocker bearings keep it in proper alinement, and by supporting its entire weight, lessen the possibility of friction in the main hydraulic cylinder, piston rod glands, and in various other bushings through which the drawbar passes.

In each end of the cylinder are two automatic valves (Figs. 3-4) arranged to transmit the pressure within the cylinder to the weighing mechanism irrespective of the direction of motion of the piston, thus making it possible to record either push or pull on same side of the datum line of the diagram. Valves "57" communicate with the weighing apparatus and are termed the "high-pressure" valves, while valves "58" are termed "low-pressure" valves and communicate with the supply tank. With the main piston in mid-position (Fig. 4), all valves are slightly open and a state of equilibrium exists in the two ends of the cylinder, under which condition the line made by the drawbar pull pen coincides with the datum or no-load line on the diagram. A movement of the piston either to the right or the left operates the four valves simultaneously. In the end of the cylinder toward which the piston has moved, valve "57" is opened and valve "58" is closed, thereby placing this end of the cylinder in communication with the recording cylinder and preventing high pressure oil from flowing back to the supply tank. In the other end of the cylinder a reverse operation takes place, valve "57" is closed, while valve "58" is opened, allowing oil from the supply tank to flow in and fill the additional space caused by the movement of the piston away from that end of the cylinder.

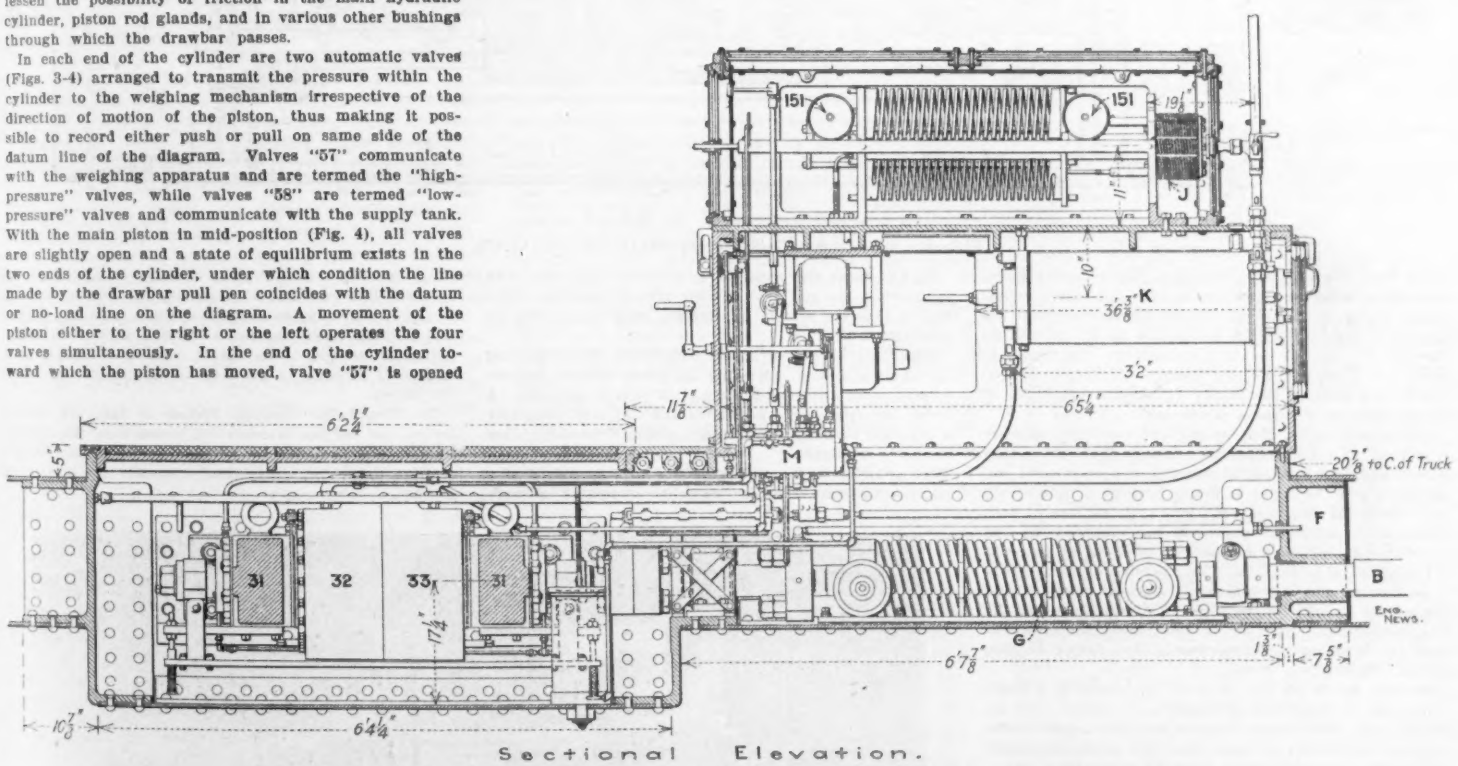
around the cylinder and carrying at the rear the vertical plate "164," to which one end of each of the recording springs is attached by means of knurled screws. This carriage is supported by four ball bearing wheels, "151" (Fig. 3), which run on a track. A rod "139" extends forward from the frame of this carriage, out through the casing surrounding the weighing mechanism and carries at its extremity the drawbar pull pen as well as the slotted guide for the arm of the integrator. The normal movement of the piston within the recording cylinder is 10 ins., but a system of stops and buffer springs J (Fig. 3) allows an additional movement of 0.8-in. in case the weighing mechanism is accidentally overloaded. The vertical plate "109" (Fig. 7) supports the forward end of the recording cylinder and likewise serves as a stop for the weighing springs, which are fastened to it in the same manner as their opposite ends are fastened to plate "164" on the carriage.

the leakage past the piston a complete system of tanks, piping, and pumps is provided. Inside the car and directly below the roof is the supply tank which is connected with the low-pressure valves of the main hydraulic cylinder. Interposed between the main and recording cylinder is a cooler K (Fig. 3), in the end of which is a needle valve which can be controlled from the operator's table and which is used to throttle the passage of the oil, thus producing a more or less wavy pull line as may be desired. In case of necessity this valve can be closed, thus protecting the weighing mechanism from any undue strain that might otherwise be transmitted from the main press cylinder.

The leakage past the piston in the recording cylinder, together with that past the piston rod glands of the main cylinder, is conducted through a system of piping to the leakage tank L (Fig. 3). Inside the leakage tank is a float, which on being lifted closes the circuit and starts a motor-driven pump whose function is to return the excess leakage to the supply tank. If on account of leakage past the main piston or for any other reason, the piston leaves the center line of the cylinder more than ⅝-in., a second electrically driven pump is started, its function being to return the piston to its mid-position by pumping oil into the end of the cylinder toward which the piston has moved. Both of the electric pumps are supplemented by hand pumps, which in case of failure of the former can be used to accomplish the results mentioned above. The valve block M for the four pumps is just below the two motors by which the pumps are driven. Both the height of the oil in the leakage tank and the position of the main piston with respect to the center line of the cylinder, are shown by indicators at a point conveniently observed by the operator.



Plan.



Sectional Elevation.

FIG. 3. WORKING MECHANISM OF DYNAMOMETER CAR FOR PENNSYLVANIA RAILROAD.

WEIGHING MECHANISM.—The recording cylinder "111" (Fig. 7), connected at end H to the main hydraulic cylinder, is 40 ins. long by 2 17-32 ins. inside diameter, and has a piston area equal to 1-36 that of the main cylinder. It is provided with two pair of pistons "124" held at either end of a two-wheeled spring-supported carriage. They are carefully fitted to the cylinder and instead of being packed have quadruple spiral grooves cut on their outer surfaces, insuring even lubrication and reducing friction to a negligible amount. The piston rod, "139" A, is connected to the frame of a carriage built

The scale of value of the pen movement in pounds per inch of ordinate is dependent on the capacity of the springs used, and can be varied to suit conditions by combinations of different springs, giving ordinates from 1,000 lbs. per in. to 10,000 lbs. per in., excepting the 9,000 lbs. ordinate. To secure these various combinations, a total of eight springs has been provided. They are always used in pairs, there being one pair of 1,000 lbs. capacity, one pair of 2,000 lbs. capacity, and two pairs of 4,000 lbs. capacity. In order to secure springs of great uniformity throughout their entire range of movement, they were cut from solid cylinders of nickel steel after hardening, instead of being wound from bar stock and then hardened. They were carefully calibrated and corrected by hand scraping, until their errors were within allowable limits. The force actually resisted by the springs is 1/28 of the load on the drawbar as the piston areas of the recording and main hydraulic cylinders bear this ratio.

For supplying oil to the cylinders and taking care of

RECORDING MECHANISM.—The paper, or recording mechanism (Fig. 5), is driven from the forward axle of the rear truck. The wheels on this axle are 33 ins. in diameter, straight faced and have no brakes. Motion is

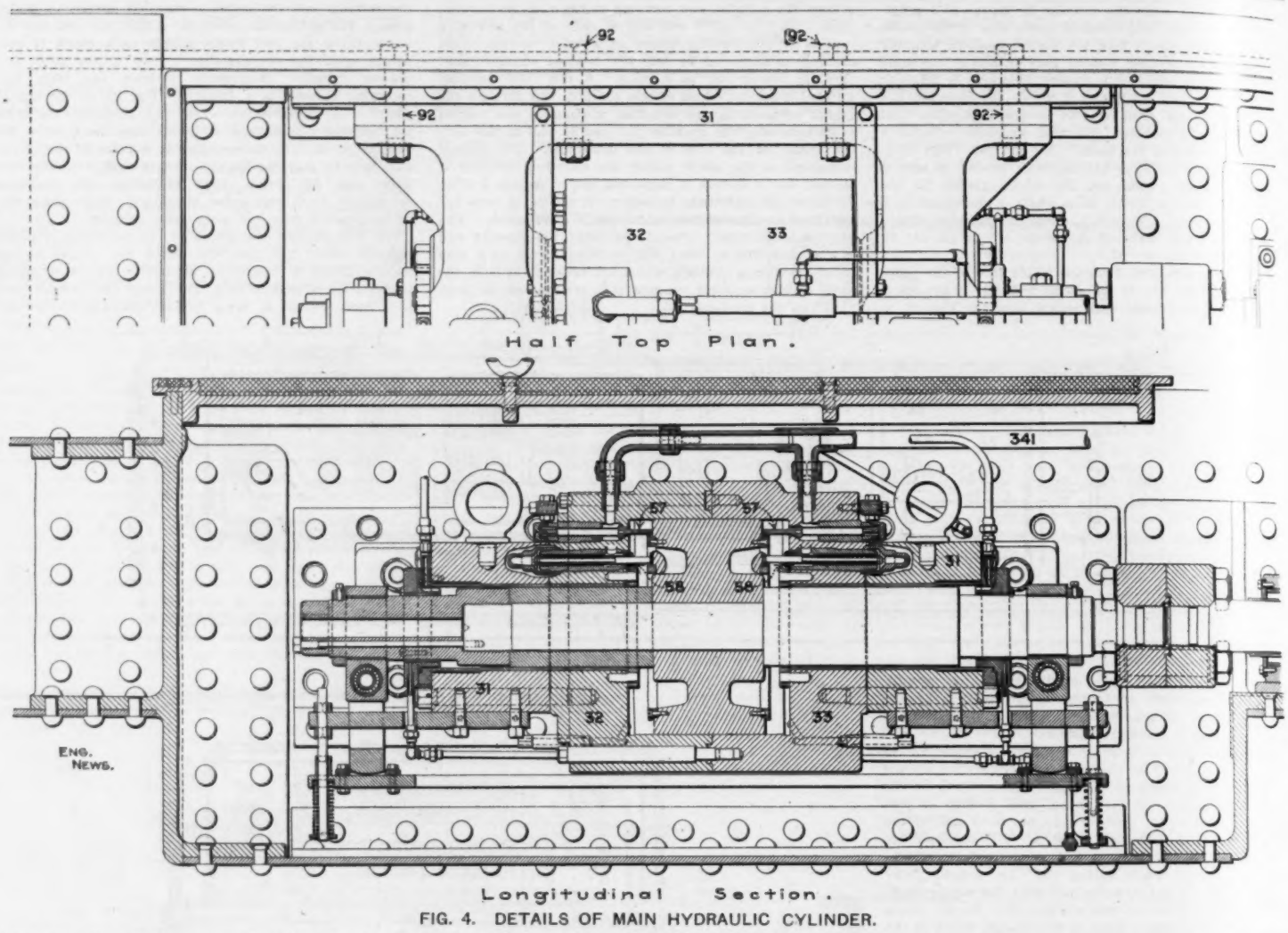


FIG. 4. DETAILS OF MAIN HYDRAULIC CYLINDER.

taken from the axle by means of a pair of spiral gears, the driver being cut directly on the axle and the follower keyed to the transmission shaft, whereby the motion is carried forward a distance of 21 ft. and up through the floor to the feed mechanism. By means of gears and a clutch, the movement of the paper is controlled and kept in the proper direction, irrespective of the direction of movement of the car.

The various guide, feed, supply and receiving rolls are supported in the framework underneath the record table. The feed mechanism consists of a corrugated roll against which the paper is firmly held by a rubber roll. The corrugated roll is of such size and revolves at such a rate as to draw the paper off the supply drum and across the record table at the rate of 1 in. of paper to 100 ft. of travel of the car. The receiving drum is driven by a friction disk, by means of which it revolves just fast enough to take up the paper as it comes through the feed mechanism. Tension in the paper can be regulated by adjusting the compression of a spring bearing against the friction disk.

The zero or datum line is made by means of a small wheel, the circumference of which is in contact with an inking pad, and which revolves as the paper passes under it. Provision is made for eight additional lines, each made by an electrically operated styiographic pen.

The first indicates whether the load on the machine is a push or a pull.

The second, in circuit with the integrator mechanism, records the area of the diagram (in square inches) between the zero and the pull lines.

The third, in circuit with a chronometer, indicates the distance passed in five-second intervals of time.

The fourth, in circuit with a roller which bears against the paper, indicates every thousand feet traveled by the car.

The fifth, operated by an observer on the locomotive, records the time of taking indicator cars.

The sixth, operated by an observer on the locomotive, records the steam pressure, also the throttle and reverse lever positions.

The seventh is used to denote locations, such as mile posts, stations, signal towers, curves, tangents, etc. These are noted by the observer at the lookout window, the observer's key being a permanent fixture on the panel of the window.

The eighth and last pen is reserved for such extra or special information as the occasion may demand.

Fig. 5 shows the appearance of the record table with the instruments and pens in their various positions, while Fig. 6 shows a section of diagram reproduced from an actual record.

HEATING AND LIGHTING SYSTEMS.—For supplying the lighting system, operating the pump motors, and recording pens, a storage battery of 32 cells is provided. A direct connected kerosene engine and 1.37-KW. generator is provided to charge the storage batteries when no other means is available.

The cylinder of the oil engine is cooled by means of a calcium chloride solution which is circulated through the jacket by a small pump directly connected to the engine. The radiator is placed on the roof of the car alongside the deck, on the side opposite from the engine; this position being chosen to effect a more even distribution of weight. The engine muffler is placed in a horizontal position on the roof of the car directly above the engine.

The Frumveller Heating System is installed, but if desired the car can be heated by steam from the locomotive, or when standing at division points for any length of time, from the steam lines generally found at such stations.

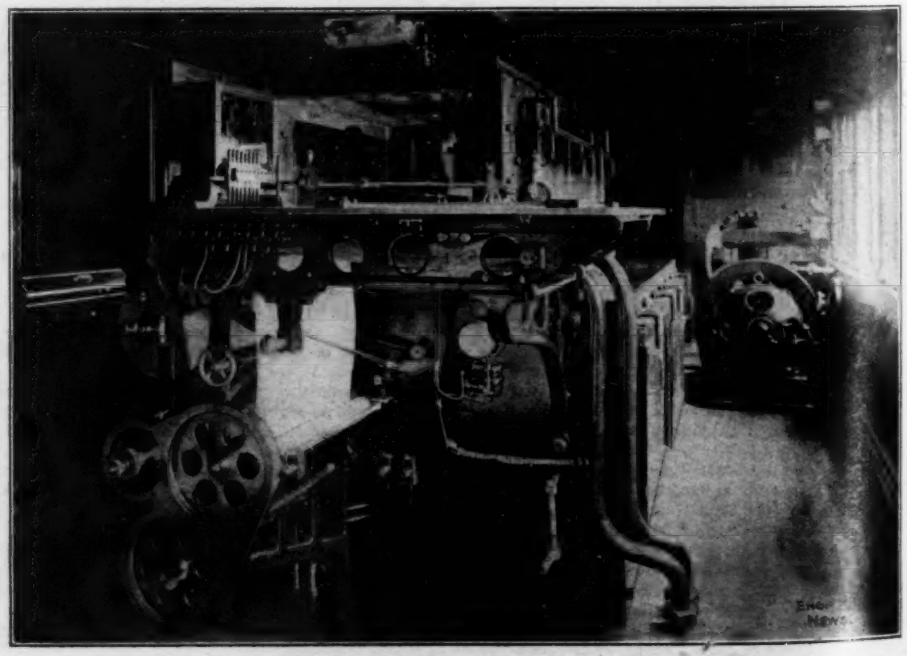


FIG. 5. RECORDING TABLE ON DYNAMOMETER CAR.

ANNUAL CONVENTION OF THE RAILWAY SIGNAL ASSOCIATION.

The eleventh annual convention of this association was held at Milwaukee, Wis., Oct. 8 to 10. The headquarters were at the Pfister Hotel, but the meetings were held in the auditorium of the new Public Service Building.

The association has now nearly 900 members, and is a strong and active organization. A large part of its work is in the preparation of specifications covering various departments of signaling and interlocking. While this is a work of great importance, it relates largely to matters of detail which can hardly be made clear in our report of the proceedings. There were no individual papers. The attendance was large, and the discussions were active.

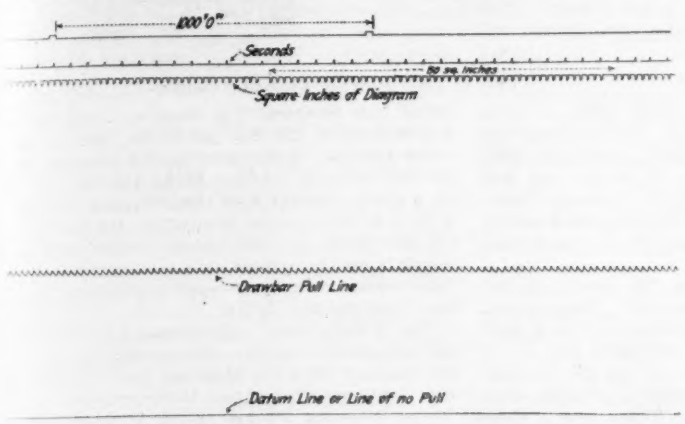


FIG. 6. RECORD MADE BY PENNSYLVANIA R. R. DYNAMOMETER CAR.

The opening session was called to order about 11 a. m., Oct. 8, when the Mayor, Mr. Becker, gave an address of welcome. The President, Mr. J. A. Peabody (C. & N. W.) then read his annual address, in which it was suggested that in future all reports for presentation at the annual meeting should be delivered to the Secretary in August, and that the annual meeting should be held in November, so as to allow time for the consideration of matters which may be presented at the regular meeting in October.

The first business was the discussion of proposed amendments to the constitution, one of which provides for "representative" members, to be appointed by the railways, as in the Master Car Builders' Association.

STANDARD SPECIFICATIONS FOR ELECTRIC INTERLOCKING.

The discussion of this committee report and the proposed specifications occupied the greater part of the morning session and the entire afternoon session. The specifications were discussed paragraph by paragraph at considerable length. The objections made were partly technical and partly relative to the inclusion of clauses which seem more properly to belong to the contract than to the specifications. The committee claimed that this had been done so as to define the business relations between the contractor and the purchaser during the progress of installation. It was also pointed out that owing to the very recent development of electric interlocking the specifications cannot now (and perhaps never may) deal with details in the same way as is done in specifications for mechanical interlocking. Although the signal companies are as much affected as the railway companies, their representatives had little to say in the discussion, which was left almost entirely to the railway engineers. At the close of the afternoon session, when only half the specifications had been dealt with, it was voted to refer the report back to the committee for further consideration, and its discussion will be continued at the regular meeting. This was done partly to give time for other matters and partly because it is evidently too early for the association to adopt any standard specifications for electric interlocking.

LOCKING FOR DRAWBRIDGES.

On Oct. 9 the meeting was called to order about 10.15 a. m., and the report of the Committee on Standard Specifications for Mechanical Interlocking was accepted as a progress report, without discussion. It was not read, having been printed in advance. The principal feature was a set of specifications for drawbridge work, this being the standard form of specifications with the necessary special modifications. The specifications submitted by this committee (A) and the committee on electric interlocking (B) both contained provisions for locking, as follows:

(A). A separate lock must be provided for each of the following purposes: 1, Locking bridge in proper alinement; 2, Locking rails in proper position for train movements; 3, Locking shore end of pipe lines when bridge is uncoupled; 4. To prevent the application of power on draws operated other than manually for the purpose of opening draw or lifting rails before all signals, derails and locks are normal.

(B). A separate locking arrangement must be provided for each of the following purposes: 1, To insure that the bridge is in proper alinement; 2, To lock the bridge; or, to lock the bridge latch in the engaged position; 3, To lock all lifting rails in proper position for train movement.

BLOCK AND INTERLOCKING SIGNALING.

Both sessions were devoted entirely to the consideration of a brief report of the Special Committee on Interlocking and Block Signals. This had been submitted to a committee of the American Railway Association and there was some lengthy discussion as to how far the Signal Association should go in regulating its action by the opinions or proceedings of the railway association. One part of the committee favored a distinction between block and interlocking signals, while the other part thought such a distinction unnecessary. When an engineman is stopped by a signal, it is not necessary to advise him whether it is a block or an interlocking stop. An extract from the report is given below, with the list of indications to be included in a complete system of signaling:

A system of fixed signal indications may be based upon either of two assumptions: (1) That signals should indicate to the engineman what is required of him in the control of his train and also the reason for the required action. (2) That the engineman needs to know only what is required of him in the control of his train.

Since the purpose of signals is to give to the engineman of moving trains information or instructions that must be acted upon without hesitation, it is plain that the indications of the signals and the means of giving them must be such that the meaning can be grasped instantly, without conscious study or effort. It is taken to be self-evident that, as the number of different instructions conveyed by the signal aspects increases, it becomes increasingly difficult for the engineman to remember the meanings of the aspects used, especially any that are not often met with in his daily routine, and the chance of wrong reading increases. In addition, the practical difficulties in the way of displaying a large number of distinct aspects must be taken into account. Tested by these considerations, the first assumption, followed to its conclusion, is found to require too many aspects.

While it is assumed that the engineman must be fully acquainted with the unchanging physical characteristics and the running rules of the road or portion of the road over which he runs, including locations of fixed signals, it is realized that the engineman's mind should be relieved, as far as possible, from the necessity of remembering what each signal is for; and plainly this can be done only by giving more indications than would be required in a system based strictly upon the second assumption.

It is, therefore, the conclusion of the committee that, in a system of signal indications, the aspects should primarily serve to indicate what is required of the engineman in the control of his train, and secondarily should provide for the giving of certain additional useful information, limited by the reasonable practicability of displaying the necessary aspects and the added burden upon the engineman's memory that will result from the use of many aspects.

REQUISITE INDICATIONS FOR A METHOD OF UNIFORM SIGNALING.

A. STOP.—1. Stop here until authorized to proceed. (For both interlocking signals and manual block signals.)
2. Stop here and then proceed. (For automatic block signals.)
3. Stop here and investigate. (For automatic block and stop signs.)
B. PROCEED: CLEAR.—4 and 5. Proceed on unlimited (5, or limited) speed route; next signal is at "proceed." For interlocking signals.)
6. Proceed. (For interlocking, manual block and automatic block signals.)
7. Continue. (For switch signals and track-tank signs.)
8. Restriction removed. (For signs removing slow-sign restrictions.)
C. PROCEED: CAUTION APPROACHING.—9. Proceed prepared to stop at indicated point ahead. (For distant signals of Nos. 1, 2 and 3.)
10 and 11. Proceed on unlimited (11, limited) route; next signal is at "stop." (For interlocking signals.)
12. Proceed, prepared to pass next signal at limited speed. (For distant signals of No. 5.)
D. PROCEED: CAUTION HERE.—13. Reduce speed. (For slow signs.)
14. Proceed on low-speed route; next signal is at "proceed." (For interlocking signals.)
15. Proceed at low speed. (For interlocking signals.)
E. SUPPLEMENTARY INDICATIONS.—1. Take siding here; 2, Take siding at next station; 3, Proceed, but block is occupied. These three are for manual block signals.
Note 1. Manual block includes telegraph block, staff block and controlled-manual block.
Note 2. Indication No. 7 may also be given at interlocking signals which are not block signals where permissive blocking is used; at block stations ("block station closed"); at train-order signals ("no orders"); and at flag station signals ("no passengers").

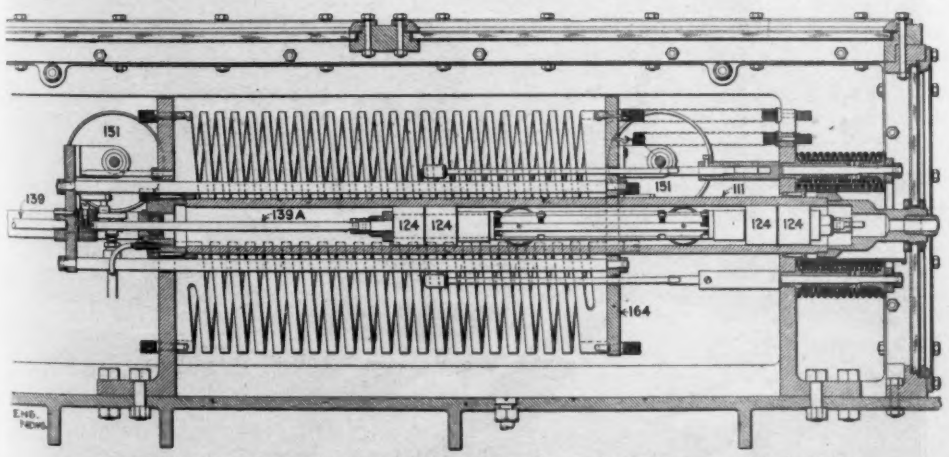


FIG. 7. RECORDING CYLINDER AND HELICAL SPRINGS ON DYNAMOMETER.

SIGNAL LAMPS.

This was the first report taken up at the morning session on Oct. 10. In previous years this committee has dealt with the design of lamps, and in the present report it suggested the desirability of definite standards of dimensions for lamps, so as to eliminate the present confusion due to numbers of different types of lamps and brackets. The committee has found by investigation that many variations in the vital dimensions are just enough to prevent interchangeability and could readily be modified to a common standard. As to the size of lens, 5 ins. and 5⅜ are almost universal, 4½, 6 and 6⅜ ins. being used in some cases. The white bullseye formerly used for the back-light is not now considered satisfactory. It is being rapidly replaced with plain ground glass, which serves the purpose and eliminates the possibility of a confusion of signals. The prism glass reflector is meeting with considerable favor, due to its ability to increase the power of the light and to the fact that its reflecting power does not de-

teriorate with service, as is the case with metal reflectors. The report was accepted as a report of progress.

MAINTENANCE OF AUTOMATIC BLOCK SIGNALS.

This committee presented a short but systematic and practical report, and some notes from this are given below:

The efficient maintenance of any extensive system of automatic block signals requires an effective organization, and the following, as used on various roads, is conducive to the best results. It applies to a road operating under a divisional organization. It provides for a signal supervisor on each division, reporting to the division superintendent and having charge of all signal maintenance matters on the division. The efficiency of signal maintenance will depend to a great extent upon the degree to which he devotes his attention to personally inspecting in detail the work of those under him. The division should be further divided into districts 100 to 150 miles in length, each in charge of a district foreman reporting to the signal supervisor and directing the work of maintenance and repairs on his district. Ultimately each district is divided into sections of such length that the work involved on each section can be handled by one man without an assistant. It is considered advisable to limit a section to this length rather than to increase the length and consequently provide the maintainer with a helper. With the shorter section, solely in the care of one man, greater assurance is given that each detail of the work will be given a closer and higher class attention, and should anything occur to show a lack of such attention, there is no question as to where the responsibility lies.

The chief factor in successful maintenance then remains in intelligent inspection: daily on the part of the maintainer, and as frequently as possible on the part of his superiors. Conditions will be still further bettered by a regular inspection of details by some representative of the signal engineer's office. Close inspection in anticipation of trouble is the most important duty of a maintainer, and yet too often it is the most difficult service to obtain from him.

For the use of the maintainer in his daily rounds, we recommend some light form of motor car, not with the idea of gaining speed, but to relieve him of much of the hard labor expended in traveling against winds and ascending grades. Speed is desirable at certain times, as when answering a call for repairs, but ordinarily it is too apt to lead to superficiality in inspection. The maintainer has certain fixed duties to perform, such as cleaning and filling lamps, cleaning batteries, repairing insulated joints, etc. These may be done at different times, and engage a certain percentage of his time, but the amount of such work should not be so great as to preclude the possibility of his accomplishing all of it without undue haste, and still with a balance of at least 50% of his time remaining available for patroling and inspecting his section.

Experiments to determine the effect of burnettized ties on track circuits are not quite complete, but it is probable that the result will be to make it necessary to reduce the length of track circuits. A form of ballast section which will leave the rails entirely clear of the ballast should be adopted within block signal limits to avoid circuit troubles during wet weather.

If oil lamps are used for signal lights, we recommend the use of long burning founts with reflectors. These provide a satisfactory light with marked economy of labor. There is nothing gained by the use of an inferior grade of oil. While these lamps require attention only once in seven days, daily inspection of lamps and colored roundels should not be neglected.

This report was accepted, as was that of the Committee on Maintenance of Manual-Controlled Signals, but the latter was not read. As to the question of organization, we quote the following from this report:

The division to be maintained should be divided into sections of a certain number of block stations which can be handled by a small force of men, a repairman, an assistant repairman, batteryman and helper. The length of each section to depend upon the amount of apparatus and the train facilities which enable the men to cover the section. The proper care of the manual controlled system will need two classes of labor, viz., the repair force for the sections above described whose duty it will be to inspect all apparatus and make minor repairs and cover all battery work, and a construction gang covering the entire division for general repairs to both block stations and lines. It is recommended that this gang be sub-divided into two minor gangs, one for the work at the block stations and the other for maintenance of lines and cables.

Mr. C. C. Anthony (Pennsylvania R. R.), of the Committee on Definitions, reported that preliminary work has been done for the preparation of a "Dictionary of Signaling," based on the same system as the "Car Builders' Dictionary" and the "Dictionary of the Locomotive." The work is under the general supervision of this committee. The report of the Committee on Rubber Covered Wire and Cables, presented by Mr. A. H. Rudd (Pennsylvania R. R.), precipitated an animated and protracted discussion, especially from representatives of manufacturers of signal wire, who considered that the present specifications discriminate against their products.

A proposition to change the present specifications for rubber-insulated copper signal wire was voted down but by request of Mr. Rudd it was voted to refer the report back to the committee with a request to consider the arguments put forth by the firms affected. It was remarked that a copper-clad steel wire has now been put on the market, and would be excluded by the specifications, but it was pointed out that these refer to rubber-insulated copper wire, and do not apply to the new product. It was generally admitted that rubber insulation must have 30% (by weight) of Para rubber to be efficient, but the greatest objection was made to the provision that 70% "shall consist of mineral matter only." This will be thrashed out between the committee and the manufacturers.

During the closing session the report of the Secretary-Treasurer was presented. This showed a net membership of 897 members on Oct. 1, and a cash balance of $1,718 for the same date.

The annual banquet was held on the evening of Oct. 9, and there were some excursions after the close of the convention. There was a good display of exhibits on the top floor of the Public Service Building, and notes of these are given in the column of Industrial Notes in the Construction News supplement of this issue. The election of officers resulted as follows: President, A. H. Rudd (Pennsylvania R. R.); Vice-Presidents, L. R. Clausen (C. M. & St. P. Ry.) and H. S. Balliet (N. Y. Central Ry.); Secretary and Treasurer, C. C. Rosenberg, Bethlehem, Pa. The next annual meeting will be held at Washington, D. C.

CONCRETE FLOOR IN CONCOURSE OF HUDSON TERMINAL BUILDING, NEW YORK.

The accompanying half-tone (Fig. 1) is reproduced from a photograph of the floor system of the Manhattan terminal of the Hudson Companies' tunnel across the North River at New York City. A description of this tunnel and terminal appeared in our issue of January 3, 1907, p. 14.

FIG. 1. CONCRETE FLOOR SYSTEM NOW BEING PLACED IN CONCOURSE FLOOR OF HUDSON TERMINAL BUILDINGS.

The system of floor support here employed is known as "Ferroinclave Arched Floor Construction," and is shown in detail in Fig. 2. It consists of arched plates, of peculiarly corrugated No. 24 sheet iron, butting against the lower flanges of the floor I-beams, and filled over to the proper level with a 1:2:4 mixture of concrete. The lower sides of the arched plates were covered with a 1:2½ mortar, which also extended under the beams, being there reinforced with

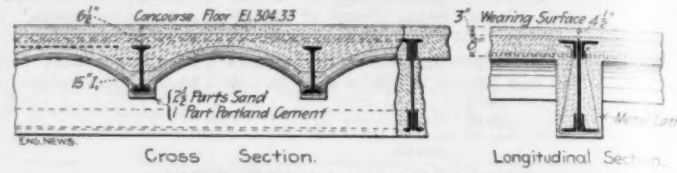


FIG. 2. DETAILS OF FLOOR SYSTEM.

metal lath hangers. The floor was designed for a live load of 125 lbs. per sq. ft., but in many cases the size of the floor beams necessitated a greater depth of concrete filling and thus provided a much stronger floor than required. In addition to its high degree of strength, the main claim for advantage of this system is the ease with which it may be erected, without falsework or any interference with other work which may be going on in the floor below.

The "Ferroinclave" construction has had a long and successful use in roof construction, but it is but recently that the idea has been extended to floor systems. The patent is the property of the Brown Hoisting Machinery Co., of Cleveland, O.

AN AERIAL CABLE TRAMWAY has been built at Chicago, extending 7,500 ft. out into Lake Michigan, for the purpose of handling excavated material from the intermediate shaft of the new 2½-mile water supply tunnel. The shore terminal is at the foot of 73d St., where the contractors have installed a large power plant and machine shop. The steel towers are 300 ft. apart and 35 ft. high above the water, the depth varying from 9 to 34 ft. Trolleys on the stationary cable carry steel buckets of 12 cu. ft. capacity, which are hauled by a traveling cable running at 450 ft. per minute. Some of the buckets are fitted with seats and carry the workmen, inspectors, etc., to and from the work. The driving drum of the plant is operated by electricity. This interesting method of handling materials and supplies was devised by Mr. Geo. W. Jackson, of Chicago, the contractor for the lake tunnel, and the tramway was inaugurated with some ceremony by a visit of some 50 engineers, city officials and others on Oct. 9. The trip to and from the temporary crib proved almost too much for some of the party, owing to the motion of the buckets and their swaying in a high wind. A lunch, dinner and visit to the horse show formed part of the celebration.

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In this issue is printed a comprehensive article on the electric traction system recently placed in service on the Rochester Division of the Erie Railroad, in New York State. To a casual reader this extended treatment, of a system at present equipped with a comparatively small amount of rolling stock, might seem unusual and perhaps unwarranted. However, it will be seen at once that the installation is noteworthy and significant; that it is a decided step in the development of heavy electric traction and deserves attention, not because of the local service itself, but because of the possibilities of the system developed.

It is obvious that the heavy and expensive construction necessary for high-tension traction on a trunk line is needlessly expensive for the ramifications of a railroad system like the New Haven network of lines. Lighter traffic over branches and feeders demands, for an economical system, cheapened construction. Safety and operating cost demand that it should still be extremely substantial. The Erie installation seems to have struck the desired compromise and it is interesting to note in what particulars reduced cost has been possible.

The heavy steel supporting bridges of the New Haven system have been replaced with chestnut poles bearing steel brackets. The double, cradled catenary has been replaced by a single cable. While the Erie line has been divided into sections, these are merely for convenience in locating trouble and do not form a part of an extensive system of power transmission and control as in the case of the New Haven Road. In fact, on the Erie there is no such extensive system and there is, in consequence a great reduction in the amount of auxiliary apparatus. There are no auxiliary feeders or by-pass wires, the entire 11,000 volt current flowing over the catenary construction.

The extension of electric traction over the network of the New Haven system is promised for some future time. It may confidently be expected that the Erie installation has shown the way in which this and similar extensions will be made where the lighter traffic prevails.

It will be remembered that the system of high-tension, single-phase traction for the New York, New Haven and Hartford Railroad up to the present includes only electric locomotives and no motor cars for multiple-unit trains, though it is generally understood that these will be added at some future time. It follows that on the New Haven Road, current at 11,000 volts does not enter into or upon a car in which passengers are allowed to ride. Desirable as this point may seem to some engineers, it can not be maintained with multiple unit trains. Cars carrying passengers must also carry high-tension apparatus.

The Public Service Commission of New York City is performing a very real public service by the probing it is administering to that overgrown ulcer upon the body politic, the New York street railway corporation. When a private individual indulges in frequent changes of name he is regarded as a suspicious character; and the same rule appears to hold good with that maze of corporation entanglement which holds the title to New York City's street railway system.

The main purpose of the Public Service Commission's investigation, of course, is to find out why it is that the New York street railways cannot earn money enough to pay their debts or the interest on them and at the same time render decent service to the public. Why it is, for example, that they have not bought a new car in five years.

As we showed two weeks ago, the street railway system is staggering under a load of bonded debt enormously out of proportion to the property it owns. The Public Service Commission is trying to find out what this debt represents—whether the public is paying interest on the cost of building the road or interest on "water" and "graft."

In the "Construction Account" of the company, the Commission has found that some $975,000 was paid out on account of the "Wall & Cortlandt Streets Ry.," a line which was never built and never even attempted to be built. From the testimony of Mr. Anthony N. Brady before the Commission last week, it appears that Mr. Brady originally secured a franchise for this road and instead of constructing it he sold the franchise to the street railway combine for $250,000 in round numbers. When he received his pay, however, he was given a check for $965,607.19 and instructed to make out five checks each for $111,652.78 payable respectively to P. A. B. Widener, Thos. F. Ryan, Thos. Dolan, Wm. C. Whitney and Geo. W. Elkins (these five parties being directors of the New York City railway combination), and one check to Moore & Schley, brokers, for $134,028.92.

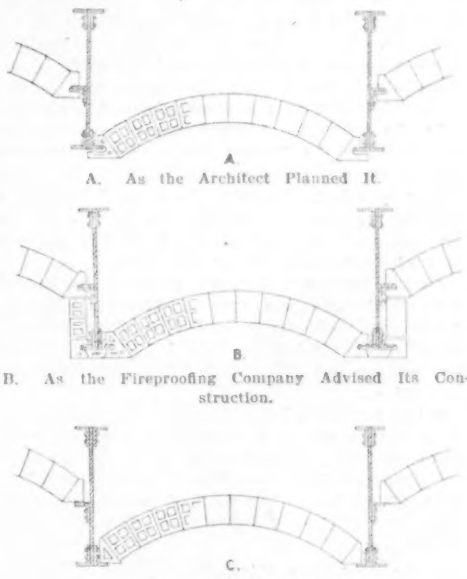
Inasmuch as some of our readers may possibly have been grieved at the language we used concerning this remarkable street railway corporation two weeks ago, we have deemed it proper to print here the above abstract from official records.

We may not take space here to relate other astonishing items which have gone to swell the "construction cost" of this street railway system; but it is proper to record that there are strong indications of the company's funds being used to run an "anti-municipal ownership" press bureau. In line with this sort of work is the revelation that about one-third of the expenses of the "Municipal Ownership Investigation," conducted by the Civic Federation, were paid out of the New York Street Railway Company's treasury. The genial gentlemen who earn their living by exploiting street railway franchises were apparently of the opinion that a few thousand dollars to aid a project which was fairly certain to either give municipal ownership a black eye or else "damn it with faint praise" would be money well expended.

There are many intelligent men, however, who believe that our public work must be done through private franchise-holding corporations; because with all their franchise grabbing and financial irregularities, the actual work of construction and management is carried on efficiently.

We have no quarrel with those who honestly hold this view; but we do ask them to be certain of their facts.

And in this connection we invite attention to one single illustration of street railway management in New York City. Last week a car barn on Fourteenth St., belonging to the New York City Street Ry. Co., caught fire. The structure was built only five years ago, and was *supposed* to be fireproof. Chief Croker, himself, head of the Fire Department, led the attack on the flames and went with a company of firemen in-



A. As the Architect Planned It.

B. As the Fireproofing Company Advised Its Construction.

C. As Actually Built.

"Fireproof" Floor Construction for the 14th St. Car House of the Metropolitan Street Ry., New York City. Erected, 1902; Destroyed by Fire, Oct. 9, 1907.

side the burning building. Once there, however, he saw the steel beams overhead glowing with heat and bending under their load; and the firemen were ordered out, the last one barely escaping before the floors of the building with their load of cars came crashing down.

The results of the fire, besides the destruction of the building, were the loss of a large number of cars, and consequent serious public inconvenience, endangering of adjacent property and of human life, and, like every other fire, loss of wealth which in the end has to be borne by the community as a whole.

Now who was responsible for the gross blunder of erecting a "fireproof" car barn in the heart of New York City and making it an easy prey to flames by neglecting to protect the underside of the floor beams? Without attempting to answer this question we submit the accompanying three sketches. The first, Fig. A, shows what the architect designed. It will be seen that he provided skewbacks to cover the lower flanges of the floor beams and his specifications demanded such construction. He left, however, part of the lower side of the beam in each alternate arch unprotected. The manufacturers furnishing the terra cotta fireproofing, realizing that without complete protection to the floor beams, the structure would be fireproof in name only, offered to the contracting builder to furnish the beam-protecting skewbacks without additional cost and also the other blocks necessary to complete the fireproofing of the beams. Fig. B shows this proposed construction.

The builder, however, refused this offer, apparently because he wished to save the cost of putting these blocks in place, and the structure as actually erected, with the lower flange of the floor beams entirely exposed is shown in Fig. C.

And this street railway corporation, capitalized at over a hundred million dollars, had not enough efficiency in its management to prevent such work being done in an important building, on which the continuity of its service depended! But is this lack of efficiency, after all, surprising?

If a corporation is run by those who control it for the benefit of the "inside ring," is it likely that the men lower down, who are doing the actual work, will have any particular incentive to industry, efficiency and honest service?

The French equipment for the Panama Canal work, left on the Isthmus by the De Lesseps Company, was generally supposed to be practically worthless at the time the United States took the property over. Casual visitors to the Isthmus ever since the De Lesseps enterprise was abandoned have seen old cars and locomotives half buried in the jungle, overgrown with vines and creepers. Even where an attempt was made to keep some of this rolling stock painted, it was generally believed that the paint was only a superficial skin over a mass of worthless rust.

In the purchase of the Panama franchise and property by the United States no value was placed on the plant at the Isthmus, by either buyer or seller. In fact, the general opinion of American engineers was that the old French machinery and contractors' plant on the Isthmus was of no account except for scrap.

As our readers will recall, a lot of the French cars and locomotives were put in order when the Americans took charge and after three years of American operation on July 1 last, 100 French locomotives and 250 French dump cars were still in service.

It has generally been supposed that this equipment was used as a temporary measure, until more efficient and up-to-date rolling stock could be obtained; but from the "Canal Record" of Sept. 25 we learn that the end is not yet in the utilization of the old French material. We quote as follows:

> By the expenditure of $20,000 for labor and material an old French ladder or elevator dredge, which has been lying in the Rio Grande River above La Boca for more than twenty years has been restored in every part, so that it is now capable of excavating 120,000 cu. yds. of material per month. This dredge, when in service at the La Boca entrance of the Canal, will do more work than a modern dipper dredge costing $102,500.
>
> In reconstructing the dredge, all the essential parts used were French. These were found in the jungle or among other old French plants scattered along the line of the canal. The three boilers, which have been installed in place of the two original ones, were found in the jungle near San Pablo, where they had been lying for more than twenty years. They were in excellent condition, free from corrosion, and all bearings and fittings were in good working order. The two cylinders also came from the jungle, and were in like excellent condition. Their valves had to be reset and new rings fitted, otherwise they were in as good condition as when new. The engine, which had remained in the hull, was in excellent condition, and could not be surpassed by modern machinery, both as to adjustment and economy of operation. The copper piping on all the machinery is of very heavy design, and shows much more careful workmanship than is found in modern machinery. The remarkable preservation of this machinery was due, in the first place, to the high quality of material used in construction, and in the second place to the use of white lead and grease which covered the parts and excluded the air.
>
> The dredge is of the ladder or elevator type, similar to the old Scotch dredge A-2, which was reconstructed by the Panama Railroad Co. five years ago, and which since then has been at work in the channel from La Boca to Naos Island, with a record of less than 40 days out of commission for repairs during that time.
>
> The material removed by these two dredges is taken to sea and dumped in deep water by a fleet of eight self-propelling old French hopper barges, of a capacity of about 225 cu. yds. of material each.
>
> Another old French dredge of similar type is now being repaired in the Cristobal dry dock, and will probably go into commission about the last of October.

It is a common belief among engineers that iron and steel corrode very much more rapidly in the tropics than in the temperate zone. The reported condition of these old dredges after their long exposure appears to contradict this idea.

Readers who have followed the accounts of the Quebec bridge disaster in American technical journals and newspapers may be interested to see how the news of the accident was given to the engineering profession in Germany. The most important and influential of the German engineering journals is the "Zeitschrift des Vereines Deutscher Ingenieur." Its issue of Sept. 21, published over three weeks after the fall of the bridge, contained the first news of the disaster. We translate the item literally and entirely:

> The bridge in process of construction across the St. Lawrence River at Quebec, the largest cantilever bridge in the world, about which we already wrote in detail on pp. 361 and 459, 1907, met with a serious accident on Aug. 30. It appears that under the influence of an overloaded train, which was carrying material to the south end of the bridge, the south anchor-pier gave way, whereby some 240 m. of superstructure fell down and about 60 persons were killed. We hope to be able to give more exact news of the causes and effects of the accident in a future issue. At any rate, the completion of the bridge, and through this the opening of the Canadian Pacific line, will be long delayed by the accident.

"More exact news"—to put it mildly—would certainly seem desirable. There may even be German investors in Canadian Pacific Ry. securities who would be relieved to learn that the "opening of the line" will not be delayed until the Quebec bridge is completed!

GOVERNMENT WORK IN THE TESTING OF MATERIALS.

A number of well-known engineers interested in the manufacture of steel and steel structures held a meeting in New York City on Sept. 24. The conference was arranged, we understand, by Gen. Wm. Crozier, Chief of the Ordnance Department, U. S. A., with a view to securing advice as to how his Department can expend its appropriation of $35,000*, made for carrying on the work of testing materials, with the greatest practical benefit.

Of course, a considerable part of this appropriation must be devoted to routine testing for the Army and for other Government departments; but there is a considerable margin available for such work in the line of original investigation as may be useful to engineers.

The conference was attended by representatives of the principal steel manufacturers, of well-known firms engaged in structural work and by a number of engineers in independent practice. We understand that the discussion was chiefly over the matter of testing structural steel, both in specimen tests and in full size members; and as is entirely natural wherever engineers are congregated, the need of more tests of large compression members was especially emphasized.

Resolutions were adopted by the conference to the effect that tests of structural material should be carried out according to a definite and continuous plan, and that they should be made by a disinterested and competent authority in order to have full weight with the profession. It was further recited that such investigations concern not merely economical construction but the safety of the public; and that the federal government was the proper authority to carry out such tests. Finally it was registered as the opinion of those in attendance that the facilities now at the command of the United States for testing materials should be increased by the construction of a universal testing machine with a capacity of at least ten million pounds.

As our readers will recall, in our first issue following the Quebec bridge disaster we voiced the demand—long felt we believe by many engineers engaged in structural work—for more tests of large size compression members. The results of this conference place this demand in definite form. There will undoubtedly be brought forward at the approaching session of Congress, bills providing for the undertaking by the Federal Government of the testing of materials on a much larger scale than has hitherto been attempted. If these receive the general support of the profession, their passage is practically certain.

What attitude ought the profession to take on this subject? How far may the Federal Government advantageously go in this work of testing material? It seems to us these questions are important subjects for discussion, especially as the letters received by us from engineers reveal a considerable variety of opinions. As an illustration we print a letter received this week from a Cleveland engineer:

*This appropriation is a large increase over the former annual appropriation, which was $15,000.

Sir: During the last few years it has been almost impossible to pick up an engineering paper without running across a discussion, wise or otherwise, as to the cause of the failure of the Quebec Bridge.

To the ordinary layman it would seem that engineers would devote the same energy towards arranging for the American Society of Civil Engineers or some other competent body, to make a series of tests upon compression members of large section they would accomplish something much more valuable than these newspaper articles are doing. Notwithstanding the learned manner in which some of these men are displaying their knowledge of the theory of compression members of large section, the fact apparently remains that those ones who claim the most knowledge know the least about the actual action of these members.

It would seem as though the engineers of the country owe it to themselves to find out something definite on the subject.

As a contrast to this view we may quote an opinion of a well-known Pittsburg engineer to the effect that our present knowledge of materials and stresses is sufficient to build any practicable structure. He points out the fact that existing testing machines with capacities up to 2,000,000 lbs. have hardly ever been used for the testing of full size compression members, although they are large enough for all such members save those in a very few bridges of exceptional size. Further, he claims that even if full-size tests are made, they can do no more than verify the results of computation. We must have correct theory of the strength of component parts in order to build safe compression members anyway. The result of a full-size test holds good only for that particular member or duplicate thereof.

In our opinion, there is truth in each of these apparently conflicting views. We believe there is a real need for the full-size tests which our Cleveland correspondent calls for; yet we fully appreciate that these tests can only verify the work of the designing engineer. Correct theory of column stresses is essential to intelligent column design, no matter how many tests may be made.

If our Cleveland correspondent has in mind the contributions which have appeared in Engineering News, in his reference to "the learned manner in which some of these men are displaying their knowledge of the theory of compression members," we venture to suggest that among the contributors to this discussion have been some of the ablest and best known authorities in the engineering profession. That these contributions, appearing among our "Letters to the Editor" and elsewhere, have been of widely varying merit, we are well aware; but it has long been our policy to hold this department as an open forum for the free discussion of matters of interest to the profession. Not that all letters sent us for publication are given space there, by any means. It is our task to judge what matter is of enough interest and value to be worthy of space. In the case of the Quebec bridge, for example, we have returned many letters relating to it because their writers—from lack of information or other causes—did not present anything sufficiently interesting or valuable to be worth publication.

If our Cleveland correspondent thinks that the column tests he urges would make unnecessary such discussions of the stresses in lattice bars and the influence of imperfect butt joints as we have published, we believe he will find few supporters among engineers engaged in structural design. As a matter of fact, the discussion which has gone on in this journal during the past six weeks has been of great importance, we are certain, in advancing general knowledge of the stresses in large columns.

Turning now to the question as to how far the United States ought to go in its testing work, it will be of interest to note the article in this issue describing the work which has already been undertaken by the Geological Survey for the testing of cement and concrete on a large scale. Here is one organization undertaking the investigation of materials on a large scale and the Watertown Arsenal testing machine under control of the Ordnance Department is another. It has been arranged that for the present the Geological Survey is to confine itself to the testing of cements, concretes, stones, etc., while the Ordnance Department is to conduct tests of metals.

Of course, a large amount of testing laboratory

work is done by other departments of the Government; but the above two are the only organizations which make any pretence of original investigations of the strength of materials. Regarding now the work, which these or any other federal institution should be called upon to do, the safe rule to follow, it seems to us, is for the federal government to undertake only that class of work which cannot well be done by private enterprise or by lesser governmental bodies, such as cities or States.

Some thirty years ago there was a great demand from engineers for more data on which to base their work. There was perhaps at that time an excessive respect and over-confidence in the results of tests. Since that day testing laboratories have grown apace, many millions of dollars have been spent to establish and equip them, and a vast amount of work is being done in the way of original research. The profession has now come to the point where it has no time to use data alone. The testing laboratory which presents its results to the public in ponderous volumes of fat tables, will have little influence upon the work of the world. It is not enough to present data, but the lesson to be learned from the data—the results of the tests—must also be made clear.

There is no need, therefore, for the Federal Government to undertake testing work for the sake of testing. Nor is there need that it should do what other laboratories are already doing well. Its work should be wholly in the fields which existing laboratories cannot cover. A recent suggestion, for example, has been that the Government ought to investigate the causes leading up to the prevalent breakages of steel rails; but, in our opinion, this work can be better and more efficiently done by the laboratories of the steel manufacturers and the railway companies. Not until it is shown that these are inadequate for the task will it be time for the Government to step in.

But while we do not favor the creation by the Government of any large testing laboratory in which to concentrate all the work of investigating the strength of materials, it does seem to us worth while for the Government to enter those fields of testing work which will otherwise remain long unexplored. The testing of large columns is a matter now before the engineering profession. The largest testing machines in existence have a capacity of only 2,000,000 lbs. Admit that there are engineers wise enough to design safe columns to carry twenty, forty, sixty million pounds, and it is yet apparent that the public would feel safer if the wisdom of those engineers were subjected to actual proof. Perhaps there are many engineers, even, who would feel safer in riding over a Quebec bridge, if they knew that its members had passed an actual loading test. It is not so long ago when it was common for engineers on the other side of the water to specify that a bridge should be subjected to a proof load before acceptance and such loads were actually applied and the resulting deflections noted. In this country confidence in engineering skill is such that tests of this sort have very rarely been made; but if a great testing machine would help to maintain such confidence, it would be well worth its cost.

It is said, and probably with truth, that if a ten or twenty-million-pound testing machine were built, it would be idle almost from one year's end to the other. The cost of making such a huge member, transporting and testing it is so great that only an occasional record-breaking structure like the Quebec bridge or the Manhattan bridge would give an opportunity for its use. While at first sight this seems a strong argument against the undertaking of such a machine, we believe that it would be worth while, even for such infrequent use. The list of great bridges and high buildings is lengthening every year. We need to have our "knowledge grow from more to more" to keep pace with our material development. Even full-size tests to destruction of a dozen types of bridge members of large size might teach the engineering profession enough, we take it, to repay the cost of building the machine.

LETTERS TO THE EDITOR.

Where Is a Crossing Crossed? A Disputed Boundary Question.

Sir: We have had considerable discussion about the location of a boundary line, and I ask the indulgence of your columns for the interpretation of your readers interested.

The description reads: ". . . running thence easterly along said north line of private claim number —— to a point eighty-three rods *beyond its crossing* of the highway known as . . ."

The italics are mine, as this is the point of discussion. One contention is that the "crossing" is the center of the highway, and the other is that the "crossing" is not reached till the road is crossed; that is, the distance should be taken from the further or easterly line of the road.

Yours truly, H.

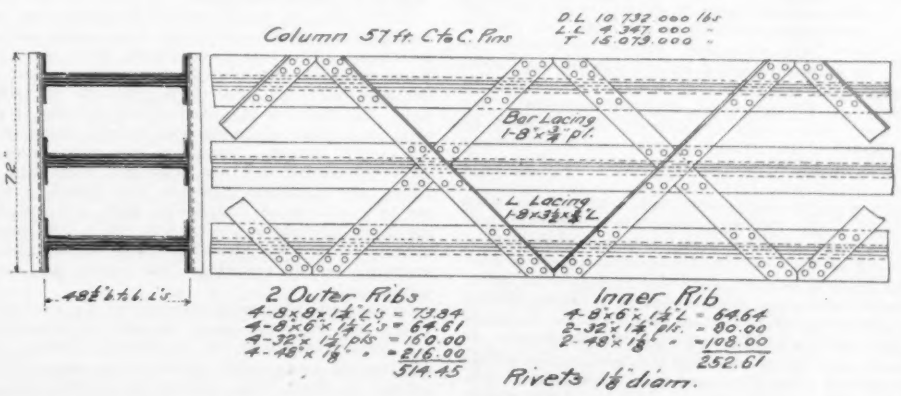
De Pere, Wis., Oct. 9, 1907.

[We doubt if anyone can give a satisfactory answer to such a question without knowing more of the facts in the case. If the object of the deed (assuming that a deed is invoked) is to delimit the north boundary of a piece of property the north side of which is 83 rods in length then the crossing would be at the point where property ownership begins, actually or nominally. Sometimes land is deeded from the center and sometimes from the outer boundary of a street.—Ed.]

The State of Knowledge of Column Design.

Sir: Without desiring to criticize, the designers of the unfortunate Quebec bridge, I do wish to take exception to the statements repeatedly made in Engineering News that there is any mysterious uncertainty in the strength of long columns of large cross section. The chords in the Quebec bridge are not a fair sample of usual American practice. The lacing used in the Quebec bridge for columns with a cross section of 760 sq. ins. and over is about what would be used in ordinary practice on sections of 50 to 75 sq. ins. It should be noticed that the column A9 has not sufficient stiffness laterally to support its own weight if laid on two supports on its side, and such columns must be subjected to initial stress due to handling in the shop and field.

I am sending herewith a sketch of a column having about the same cross-section area as A9 with lacing of



five times the strength, believing that this proportioning agrees better with usual American practice. The individual segments also have a considerable stiffness of themselves, which is essential.

The possible stress to which lacing may be subjected is a direct function of the stress in the column and an indirect function of the stiffness of the individual segments. The statement of one of your correspondents that there is no practical or theoretical knowledge of the required strength of lacing is not so. There is at least one set of experimental tests, although I do not recall at present where they are described. There is also a theoretical discussion by Prof. S. W. Robinson in his work on "Long Columns." Prof. Robinson also gives a strictly theoretical column formula which makes our knowledge of the behavior of columns under stress quite as full as our knowledge of the behavior of beams in bending. His theorem is perfectly general and applies to columns of any length or cross section. His conclusions agree with usual practice and with the experiments which have been made.

Yours truly,

F. H. Bainbridge.

Pierre, S. Dak., Sept. 25, 1907.

Full-Section Splices for Compression Chords.

Sir: The anchor arm of the Quebec bridge was erected on falsework and consequently its component parts had no stresses until the cantilevers were begun. These parts were not in their final positions, the main posts being placed with their tops inclined 15 ins. toward the shore. It is evident therefore that a considerable angular movement must have taken place at the bottom-chord joints during the erection of the cantilever arm. Butt joints were relied on to transmit the strains in the bottom chord and were faced to correspond to the angular positions taken by the chord under certain assumed conditions of stress in the trusses. The assumed condition was no doubt that of full dead load, the joints being bolted until that condition was reached. The suggestion made by several of your correspondents that such joints should be fully riveted as the work proceeded is manifestly wrong for in that case no angular movement could take place. With the joints bolted such movement *may* take place, but even bolts may hold a joint so stiffly that it may not close with all parts of the faced ends carrying equal intensities of pressure. The degree of success attained by the erectors at Quebec may have had an important bearing on the failure of the structure.

If butt joints are faced for one condition of stress in a truss and are successfully brought together and riveted, what happens under other conditions of stress? When chords are faced for their position under full load, experience shows that they cannot be brought together closely when erected. Conversely if faced for position under dead load only they will open when the live load comes on the bridge unless prevented by the splice plates. Will not these splice plates have to be sufficient to fully splice the joint in order to entirely prevent its opening?

Besides the difficulty of making butt joints that will be in correct contact when the truss receives its maximum load, there is much likelihood of slight errors in shop work. These are especially liable to occur when the facing desired is not exactly at right angles to the member, as is the case if the members are faced for their positions during erection. The deflection of chords from their own weight must also have some effect.

The objections just stated do not apply to columns in buildings where the loading does not produce angular movements, but they do raise the question whether the use of butt joints in the chords of ordinary trusses should be considered good practice. Would it not be better to make all such joints riveted joints, allowing clearance between the main members, and depending solely on the splices to carry the stresses? Field riveting is not now considered as objectionable as it used to be and the increased expense of spliced joints would be about equal to the cost of the additional material required. There will be no difficulty in making such joints in spans of ordinary length, and they will add much to the strength of the trusses when they are called on to resist abnormal stresses. Yours truly,

John C. Moses, M. Am. Soc. C. E.

6 Irving Terrace, Cambridge, Mass., Oct. 11, 1907.

[It is probable that one result of the Quebec bridge collapse will be a tendency toward the requirement that compression chords and preferably all compression members in bridges shall be spliced for their full strength, or at least to a high percentage of their full strength; and the plan of regarding the splices as simply additional fastenings and relying upon the abutting ends of the members to transmit the load will be abandoned.

There is great difficulty in securing perfect bearing of the abutting surfaces of column ends under the practical conditions of shop and field work; and as has been well shown by the discussion in recent issues of this journal even

slight inaccuracies in these abutting surfaces, cause large stresses in the columns. Evidently then, if a proper butting contact cannot be obtained, the splices ought to be made strong enough and stiff enough to take a large part of the stress which crosses the joint. The matter of the change of angle between adjacent segments of chords as the load on the structure changes, reinforces this conclusion. It is well known that theoretically, in a pin-connected structure, the chord-joints yield freely to the angular change occurring during deflection; and it is equally well known that actually the angular change causes a bending-moment in the chord, even when the chord-sections are pin-jointed, which is rarely the case in compression chords. When the chord is less rigid at one point than elsewhere, the bending will concentrate at this point. The ordinary chord splice is such a point, at least when the bearing of the abutting ends is imperfect. In consequence there is a tendency to concentrate the bending here, and to put his stress upon the splice-plates. A full-strength splice will remove this difficulty.

An important additional consideration, applying mainly to very large cross-sections, is the following: If the metal of the chord is concentrated in great thicknesses, it is very difficult to make splices with the full value of the section. To permit convenient full splicing, the section must have its metal quite thoroughly distributed. But this condition is a highly desirable one, as evidenced by the weakness of the chords of the Quebec bridge, which condition we discussed editorially in our issue of Oct. 3. Therefore, if in the specification for a bridge is inserted the requirement that compression-members must be fully spliced, much will have been done toward ensuring safe compression-members.—Ed.]

NOTES ON THE DISINFECTION OF RAILWAY CARS AT TERMINALS.*

By H. E. SMITH,† M. Am. Soc. M. E.

The term disinfectant, as popularly used, is quite indefinite and variable in its meaning. A few of the substances included under the term are genuine germicides; that is, they have the power of killing disease germs when properly used. Others are merely deodorants, having only the power to destroy, or to mask, foul odors. Still others are neither germicides nor deodorants, but merely antiseptics, and as such have the power to prevent fermentation and putrefaction. Some substances fall into more than one of these classes; for example, all germicides are obviously antiseptics. On the other hand, some germicides are worthless as deodorants. It follows then, that we cannot look to any single substance to fill all the requirements likely to arise.

The railway master painter has little use for mere antiseptics. He requires strong germicides occasionally, but for the daily work of terminal cleaning of cars and maintenance of shops and offices a good deodorant is necessary. From the standpoint of public safety the prevention of the spread of infectious diseases is obviously of the first importance. Let us, therefore, consider first the manner of killing disease germs:

Fire is the simplest, quickest and most certain germicide; infected articles of small value should be burned. Unfortunately, however, this agent cannot often be used. Dry heat, boiling water and steam have in the past been used for germicidal disinfection; when properly applied they are effective; but in certain lines are inconvenient and frequently inadmissible. In many cases of railroad disinfection it is not permissible to wet the articles to be disinfected—for example, carpets and upholstery; furthermore, it is desirable to use some agent which involves much less labor than would be required to wash all the interior of a car with a liquid. This brings us to the consideration of gaseous disinfectants.

Of these, sulphurous acid—the gas given off by burning sulphur—is the oldest representative, and is an effective and cheap material. It must be used in sufficient quantity, and the exposure must be sufficiently prolonged. Three lbs. of "flowers of sulphur" are required per 1,000 cu. ft. of space. All doors and windows must be tightly closed and cracks stopped as much as possible; cupboards, drawers and closets should be opened, and all articles spread out. If a car is to be disinfected it should be placed where it will be sheltered from the wind. Fumigation with sulphur is suitable for box, refrigerator and caboose cars, rooms in shops and similar places; but it has the unfortunate habit of blackening brass and silver and bleaching dyed fabrics, and is therefore unsuitable for passenger cars.

The germicide which combines, more than all others, efficiency, ease of application and safety, is formaldehyde. Some years ago formaldehyde was applied by means of a small portable boiler of two or three-gallon capacity, heated with an alcohol or gasoline lamp. The vapors were conducted into the car or room by means of a small pipe inserted at a keyhole or other small opening. This complication is now found to be unnecessary, two very simple methods being available. One is to pour the formaldehyde over permanganate of potash contained in an open basin; the action of the permanganate causes heat and a rapid evolution of the gas, but a portion of the formaldehyde is destroyed and lost, so that correspondingly more must be used. For each 1,000 cu. ft., 5 oz. of permanganate and 10 fluid oz. of formaldehyde are required. A simpler method, and the one which we have thus far used, is to spray the formaldehyde on to sheets hung up in the room or car. When used in this way, 8 fluid oz. of formaldehyde are required per 1,000 cu. ft. The car should remain closed for at least six hours.

Permanganate of potash itself is a substance which has long been in use as a disinfectant, and is efficient in some cases. A suitable solution is 1 oz. of permanganate of potash, and either 1¼ lbs. of sal soda or ½ lb. of soda-ash, dissolved in 1 gal. of cold water. This solution is useful for cleaning sanitary fixtures and pouring down drain pipes, but is obviously unsuitable for paint or varnish on account of its alkaline nature. The solution is poisonous, but its intense color is sufficient protection from accident.

Passing mention should be made of zinc chloride, a solution of which was at one time the standard disinfectant on several large roads. Experts in bacteriology pronounce this solution nearly valueless as a germicide, and in our experience it has little efficiency as a deodorizer for railway use.

The next substance to be considered is chloride of lime, as it is ordinarily called, which is made by saturating ordinary slaked lime with chlorine gas; the resultant compound acts as a germicide when used sufficiently strong, but it is more often used as a deodorant. It loses strength when exposed to the air, and should therefore be kept in small air-tight packages which can be used up quickly after being opened. It is best used in water solution, 1 lb. in an ordinary 3-gal. pail of water being a suitable strength. A thorough washing with this solution will deodorize the foulest places, and it may also be poured down pipes and drains. Unfortunately the solution is corrosive to paint and varnish, but for places where this property is not objectionable there is no better deodorant.

Tar products are largely used as deodorants, and when employed in concentrated form have some value as germicides. The type most largely used is a black liquid composed of a solution of rosin soap mixed with coal-tar-creosote oil. The oil is practically insoluble in water, but dissolves in a concentrated solution of rosin soap. The action of the material depends chiefly on the "tar acids" present. These are chemically related to ordinary carbolic acid, but, compared with that substance, are much less poisonous, less soluble in water, and have not such a disagreeable odor. For car cleaning the disinfectant is diluted with 100 to 200 times its volume of water, and the solution used for mopping and washing. In our experience the results are usually satisfactory.

A more recent material to be presented is a water-white, limpid fluid containing small amounts of formaldehyde and antiseptic essential oils considerably diluted. Such mixtures are made under various trade names by proprietary concerns. They are used as a spray or an addition to mopping water, and if of sufficient strength should give good results in terminal cleaning.

A considerable number of essential oils have been employed as deodorants, among them being the following: Oils of camphor, cassia, cedar, citronella, eucalyptus, mirbane, sassafras, pine and wintergreen. As actually sold, these oil deodorants are often largely adulterated with petroleum. Of the oils mentioned, eucalyptus has long had some reputation as a mild disinfectant. Oil of wintergreen is a natural compound of salicylic acid, a well-known antiseptic.

Not much actual destruction of odors can be expected from such feeble agents as essential oils, and it must be confessed that practically they offer merely another odor with which to conceal the offensive ones; indeed, the odor of some of the mixtures which have been sold is almost as bad as the foul ones which are to be destroyed. All of these oils attack rubber tiling as well as paint and varnish.

It matters not how well terminal cleaning and disinfection are performed, foul odors are apt to rise from the floor and steam pipes in the toilet rooms of cars while on the road. There is, therefore, a large field for a really effective, and at the same time odorless, deodorant. We know of nothing which really fills these requirements. The best thing available appears to be a judiciously designed mixture of volatile essential oils, used in an improved fixture which will evaporate the oil slowly so as to produce only a faint but agreeable odor. It is fair to say that if the use of such a deodorant supplements a thorough terminal cleaning with a suitable disinfectant, an acceptable result will be reached.

The railroad passenger car is fortunate in being above ground as a rule, and in being well supplied with fresh air. One could wish, however, for a return to the old-fashioned, large, rectangular, wide-opening window in the toilet room, in place of the small oval one with only a slight opening which is now common. With regard to general cleanliness we believe that the cars on the best roads make a fairly creditable showing. These things being attained, we should recommend three articles for disinfection and deodorizing: (1) Formaldehyde, for thorough fumigation in cases of infectious disease. (2) A material of the creosote oil-resinate type for use in connection with terminal cleaning. (3) A carefully selected vaporizing deodorant for use in the toilet rooms as a remedy for odors arising while cars are on the road.

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ENGINEERING SCHOOLS.

RUTGERS COLLEGE.—Plans for the new $60,000 engineering building have been accepted by the trustees and work will be started within a few weeks. The architects are Mr. D. D. Williamson, of New Brunswick, N. J., and Messrs. Hill and Stout, of New York City. A portion of the fund for the building was given by Mr. Andrew Carnegie.

The building will be erected on Neilson campus, which is a large plot of ground adjacent to the old campus.

The design of the proposed building is colonial. The main portion is to be three stories high and will have a frontage of 134 ft. and a depth of 50 ft. At the rear there will be two wings each one story in height, which are to be used for the laboratories. The materials used in the construction will be stone for the base, selected brick of two shades for the walls, and terra cotta trimmings. The roof will be of green slate. The general plan of the main floor shows a vestibule opening into a main corridor which runs the long way of the building. On either side of the vestibule are shown two large classrooms, one for the Mechanical Engineering Department and one for the Electrical Engineering Department. Besides these there are two smaller class rooms and a room for the electrical laboratory. On the second floor there are a large lecture room to accommodate 120 students, two large class rooms and two smaller class rooms. These class rooms will be used by the Department of Civil Engineering. The upper floor will be given over to the work in graphics.

Exceptionally careful arrangements have been made to secure diffused lighting. On each floor there will be at least two offices for the use of the professors in charge. It is expected that the new building will be ready for occupancy in the fall of 1908.

BROOKLYN POLYTECHNIC INSTITUTE.—Since the reorganization of the department of mechanical engineering, now under the supervision of Professor W. D. Ennis, Jun. M. Am. Soc. M. E., it has been possible to offer enlarged courses in extension work through evening classes. This work began with purely lecture courses about three years ago. On account of additions to the equipment of the mechanical laboratories, it has been possible to offer this year laboratory courses to the evening students.

A course in machine design will be given by Professor F. De R. Furman, M. Am. Soc. M. E., This course will be open to men who have completed the equivalent of one year's work in mechanical drawing, and it is intended to fit them for positions as detail draftsmen.

Courses in heating and ventilating are planned to train men in the practical design of commercial forms of direct and indirect heating systems. A course in mill engineering will cover the problems met with in the arrangement of buildings, tracks and yards for large industrial works. This will include the practical design of such features as cranes, automatic sprinklers, compressed air plants, etc. The general principles of the economic design of mill buildings and the relations of engineering equipment to factory organization will be considered.

The major course of the extension work will be that on power-plant design, given by Professor Ennis. This will start with a consideration of the power-house as a manufacturing plant, its location with regard to the raw material and the market, the choice of site and standard types of buildings. The various items of equipment will be discussed, their performance analyzed, and their relations to the general problems of design investigated. The object of the course is to fit students for actual practice in the design and construction of steam and gas generating plants. The mathematical knowledge required for admission is very elementary, as the subject will be treated without extended use of calculus or even higher alegbra.

THE "LUSITANIA" on her second westward voyage, which terminated at the Sandy Hook lightship at 1.25 a. m. on Oct. 11, lowered the time made on her maiden trip by about five hours and broke all existing hourly, average, and day's-run records for ocean steamships. Her time from Daunt's Rock to Sandy Hook was 4 days 20 hours—averaging almost exactly 24 knots per hour for the entire distance (2,782 nautical miles). Her best day's run was from noon on Oct. 8 to noon on Oct. 9, when she logged 617 nautical miles; this beat the existing record of 601 miles, made by the "Deutschland" in 1900. For the day on which she logged 617 knots, her average was 24.68 knots per hour, or 0.18 knots per hour more than that required to win the British Government subsidy. That she has not yet shown all that she can do, but will still further cut down the record, is said to be the opinion of her builders and owners.

It may be of interest to note the successive steps, during the last 50 years, in the reduction of the record for the voyage between Queenstown and New York. The table below, published in the New York "Tribune," shows these, including the "Lusitania's" two trips:

	Days.	Hrs.	Mins.
1856—Persia	9	1	45
1866—Scotia	8	2	48
1869—City of Brussels	7	22	3
1873—Baltic	7	20	9
1875—City of Berlin	7	15	48
1876—Germanic	7	11	37
1877—Britannic	7	10	53
1880—Arizona	7	7	23
1882—Alaska	6	18	37
1884—Oregon	6	11	9
1884—America	6	10	0
1885—Etruria	6	5	31
1887—Umbria	6	4	42
1888—Etruria	6	1	55
1889—City of Paris	5	19	18
1891—Majestic	5	18	8
1891—Teutonic	5	16	31
1892—City of Paris	5	15	58
1892—City of Paris	5	14	24
1893—Campania	5	12	7
1894—Lucania	5	7	23
1907—Lusitania	5	0	54
1907—Lusitania	4	20	0

This table does not include the transatlantic records made by vessels of the German lines, as their voyages are made to Channel ports and not to Queenstown and Liverpool.

A HUDSON-FULTON CELEBRATION, extending over the eight days, from Sept. 18 to Sept. 25, 1909, is proposed in honor of the 300th anniversary of the discovery of the Hudson River and the 100th anniversary of Fulton's application of steam to navigation. An elaborate provisional program has been outlined by the Hudson-Fulton Celebration Commission and will be discussed by it on Oct. 23; meanwhile the Commission invites suggestions regarding the program. Copies of the program can be secured by addressing Mr. Henry W. Sackett, Secretary, Tribune Building, New York. The Commission named consists of about 250 citizens appointed by the Governor of New York State and the Mayor of New York City. The tentative program includes water and land parades and the dedication of various parks and memorials along the Hudson River, among the former being the dedication of the Robert Fulton Memorial Water Gate being erected at Riverside Park by the Robert Fulton Memorial Association.

THE SALE OF BELL TELEPHONES in the open market was announced early this month. For the first time since the organization of the American Telephone & Telegraph Co., the parent concern of the numerous Bell telephone companies which operate systems in all parts of the country, it is intended to sell outright all types of standard Bell telephone apparatus, for both instrument and switchboard installations. This apparatus, for all the Bell companies, has been, and will be, manufactured by the Western Electric Company. This concern has for several years supplied telephones to private parties in foreign countries, and in this country some forms of apparatus, outside of the standard transmitter and receiver. It will now be possible for anyone to purchase standard Bell apparatus in this country in any quantity. Private, farmer's and independent lines may now be equipped with these instruments, and have the benefit of connection to the regular Bell companies' lines without the necessity of renting their apparatus as heretofore.

THE MOST DISASTROUS RAILWAY WRECK for the week past is reported from England. A passenger train on the London & Northwestern Ry., running too fast on a sharp curve at Shrewsbury on Oct. 15, left the rails as it was entering the station. Nineteen persons were killed and 39 injured, according to press reports. This is the third accident of this sort within a year on English roads.

Another accident on the Boston & Maine R. R. occurred on Oct. 9, this time with not such disastrous results as the recent wreck. The Boston-Montreal afternoon express on the Fitchburg division ran into the rear of a freight train. The freight caboose was destroyed and seven passengers and trainmen were injured.

The boiler of a freight locomotive on the Central of Georgia R. R. exploded on Oct. 12 while the locomotive was taking water at Reynolds, Ga. The engineer, fireman and conductor were killed.

One person was killed and eight injured in a wreck at Pratt City, Ala., on Oct. 12, when a St. Louis & San Francisco passenger train was struck broadside by a Louisville & Nashville freight train. The Pullman car, which received the impact, was thrown on its side. The reported cause of the accident is that not all of the cars in the freight train were equipped with air brakes and the train could not stop in time.

The Paris-Rome express was wrecked at St. Pierre d'Arena, France, on Oct. 7. One passenger was killed and six injured.

A broken flange on a car in a freight train caused a peculiar wreck near Roanoke, Va., on Oct. 13, on the Norfolk & Western Ry. The freight train and a passenger train were passing in opposite directions when the broken flange threw the coal car over against the passenger train. Three passenger cars were demolished, 25 coal cars piled up, one person was killed and a number of others were cut and bruised.

A DISASTROUS EXPLOSION at the plant of the Du Pont Powder Co., at Fontanet, Ind., on the morning of Oct. 15, killed 80 persons outright, injured hundreds more, and totally demolished the entire plant and practically the entire town. Fontanet is a mining town, and many miners are reported to have been imprisoned underground by the demolition of the headworks and the shaking down of walls and bulkheads in the mines. Some 1,500 people had their homes destroyed by the disaster. The shock of the explosion was so great as to be felt at Cincinnati and Louisville—the former 150 miles away; at Brazil, 12 miles distant, damage estimated at $10,000 was caused; the buildings of De Pauw University at Greencastle, 27 miles away, were badly shaken.

State Superintendent Nash of the Du Pont Powder Co., himself badly injured, is reported to have said that during the last few days trouble had been experienced with a hot box in the glazing mill, sufficient several times to necessitate stopping the machinery.

Of three distinct explosions, the first occurred in the glazing mill; the second, a moment later when hundreds of persons had run to that spot, in an adjacent mill; and before they could recover, a third mill let go. Supposedly from the heat of the fire which at once started in the debris of the demolished mills, the magazine—some distance away and containing 40,000 kegs of powder—exploded with greater force than any of the three mill explosions; but this shock, though felt at the greatest distance, caused no property damage at Fontanet: The first three explosions had completed the demolition of the town.

Two schoolhouses, one very near to the works, were wrecked with much injury to pupils and teachers. In the nearer one—a frame building—the walls were blown outward as in the vacuum caused by a tornado, letting the roof down upon those inside. The schoolhouse at Coal Bluff, two miles away, was also wrecked, with injury to many of the children.

Mr. Nash is quoted as estimating the loss to the powder company at more than $100,000. This is not the first explosion at the Fontanet plant, as in the last nine years 17 altogether have been killed there.

MORE VICTIMS of the explosion at the wheel plant of the Standard Steel Co., at Butler, Pa., mentioned in our last issue, have died of their burns. The death list at last reports was 13, and of the dozen men still in the hospital six or eight more were expected to die.

A PNEUMATIC AMMUNITION HOIST for war vessels is under development by the U. S. Ordnance Bureau. It is believed that the new hoist will effectually prevent such accidents as the one which occurred last July on the "Georgia." Some of the members of the Board which investigated that accident were of the opinion that friction on the rails carrying the ammunition car, in the type of hoist used, had ignited the charge; sparks have been observed when the rapidly moving car strikes the bend in the guide rails. The purpose of the new hoist is to prevent not only the falling of burning grains of powder, but also any such effects of friction; the carrier will travel in a heavy, seamless brass tube, preventing any possible access of sparks or burning grains to the powder delivered in the turret.

VALUATION OF RAILWAY TERMINALS AS constructive mileage, for taxation and other state purposes, was the gist of a resolution adopted by the National Association of Railway Commissioners at their convention at Washington, D. C., on Oct. 10. Under this ruling the constructive mileage of the Pennsylvania R. R. within New York State, with but a few miles of main track and its vast terminal trackage now constructing, will be close to 1,000 miles.

WATER WAS TURNED INTO THE WEST NEEBISH channel of the St. Mary's River, described on the first pages of our last issue, on Oct. 13, according to press dispatches from Sault Ste. Marie. The new channel will not be formally opened to navigation until next spring.

DOUBLE-TRACKING ON THE UNION PACIFIC R. R. is being pushed night and day, says a press dispatch from Omaha. Electric lighting equipment is being installed along the way, and three shifts of eight hours each keep the work going for 24 hours a day. Along the Lane cut-off, from Omaha ten miles westward, lights have been placed for the entire distance. This cut-off will give the road three tracks for 30 miles west from Omaha; it is a heavy piece of work, the estimated cost being $400,000 per mile.

EXTENSIVE MUNICIPAL AND ENGINEERING IMprovements at Mexico City, and at the ports of Salina Cruz, Coatzacoalcos and Manzanillo, are reviewed by President Diaz in a recent message to the Mexican National Congress. His statements are in part as follows:

At Salina Cruz the whole eastern side of the inner port has been completed, with two sheds, steps leading down to the water level, bollards and mooring rings and other necessary equipment. The dredges have removed 800,000 cu. yds. of sand and clay in the outer and inner ports, in order to obtain a depth of 33 ft.; and 140 yds. of the dry-dock have been constructed. In the grounds of the terminal station, 60,000 sq. yds. have been graded; 10,000 ft. of track have been laid; dwellings for the yard employees have been provided, and electric lights have been installed upon the wharves and in the sheds.

At Coatzacoalcos the western jetty has been carried 200 ft. farther out, so that its total length is now 3,800 ft. The depth of water in the channel between the jetties is 26 ft., and the dredges have removed 500,000 cu. yds. of sand and mud. In the terminal station yards 10,000 ft. of track have been laid and marshy ground of an area of 115,000 sq. yds. has been filled in. The electric generating station has been enlarged and the culverts for the yard put in. In the town the sewers have been laid, as well as pipes for distributing water for flushing purposes and supplying the general needs of the population.

At Manzanillo, the outside of the breakwater has been lined with 15-ton stone blocks; at its extremity 50,000 tons of rock have been dumped to form the base for the lighthouse that is to be built, and 100 concrete blocks, each weighing 30 tons, have been laid to form the platform upon which the lighthouse will be erected.

At Tampico the waterway connecting the Panuco River with the Tamiagua Lagoon has been completed for a distance of 68 miles, and the canalization of the mouths of the Cucharas, La Laja and San Geronimo estuaries has been effected. A channel has been dredged in the Chairel Lagoon for a distance of 3,300 ft. in order to connect with the Tamesi River to its full navigable length.

During the last half of the fiscal year 25,000 ft. of new sewers and 26,000 ft. of new drains were constructed in Mexico City. Work has been started on a new sewer which will serve the whole northern part of the city. About 22,000 sq. yds. of asphalt and 8,500 sq. yds. of stone paving were laid in the city during that period. At the pumping station of San Lazaro four new electric pumps have been installed to pump the sewage of Mexico City into the drainage canal; steam pumps already existed for this purpose, and now the capacity of the plant has been doubled. A corresponding increase has been obtained by the installation of a powerful electric pump by the side of the steam pump at the station of La Piedad, for the flushing of the city sewers.

THE MANY CHANGES IN SEWAGE TREATMENT methods which have taken place during the past few decades are well illustrated by a section of the annual report of Mr. R. A. MacBrair, City Surveyor of Lincoln, England, for the year 1906-'07. Appended to this report is a record of Mr. MacBrair's work as City Surveyor for the last 25 years. Our London contemporary, the "Surveyor," has summarized Mr. MacBrair's statements regarding sewage treatment as follows:

From 1877 to 1881 (to go back a little further than the period under consideration) sewers were in course of construction and the farm was laid out, the capacity of the six settling tanks being 1,128,000 [U. S.] gals. In 1881 pumping was commenced, the crude unsettled sewage running direct on to the farm through a rising main and siphon. The following year saw the installation of a system of purely mechanical subsidence, without precipitant, while four years later treatment by lime was commenced. In 1888 filter presses were introduced, and in 1891 sulphate of iron began to be added to the lime, and limekilns were built on an adjoining farm so that the corporation could burn their own material. The year 1896 witnessed big changes, polarite beds being con-

structed, the use of lime and sulphate of iron given up, and ferrozone and, later, aluminoferric being utilized as precipitants. At this time the sludge question became serious, and 16 acres of lagoons were requisitioned in the Fen for the reception of the sludge for which the presses were inadequate. Three years later sludge pressing ceased altogether, the whole of the material gravitating to the lagoons. In 1898 the construction of bacteria beds was commenced, the sewage being at first run on in a crude condition, but later after settling; and in 1902 two new settling tanks, with a capacity of 708,000 [U. S.] gals., were made and a small continuous filter commenced working. The following year witnessed the construction in concrete of a third new settling tank, of a capacity of 420,000 [U. S.] gals., the combined capacity of the nine tanks then reaching 2,256,000 [U. S.] gals., or slightly more than the present daily average flow of sewage. On Nov. 7, 1905, was completed the coupling up of the 24-in. inverted siphon with the pumps and the settling tanks, thereby more than doubling the volume of sewage that could be pumped in a day. The next day No. 19 bacteria primary contact bed was completed, bringing the total area of these beds up to 3.44 acres. Last year the revolving sprinkler, having a diameter of 95 ft. and a covering capacity of 750 sq. yds., was finished.

THE COST OF 4,233,255,645 CU. FT. OF GAS, sold by the Boston Consolidated Gas Co. during the year ending June 30, 1907, averaged 55.72 cts. per 1,000, not including interest, depreciation and reserves. Of this, 31.81 cts. was for manufacture, and 23.91 cts. was for distribution, management and other expenses. The amount of gas actually handled during the year was 4,402,775,300 cu. ft., about evenly divided between gas purchased and gas manufactured. The larger figure just named represents gas in holder, and this cost 31.30 cts. for the gas manufactured and 29.95 cts. for the gas purchased. The cost in holder of gas manufactured was distributed as follows—the final figure, as will be noted, being the net cost after deducting the value of residuals made:

Wages at works	$0.0528
Coal and coke used in making gas	.1249
Coal, coke, etc., used in making steam	.0300
Enriching materials	.1451
Purifying materials	.0014
Water	.0043
Miscellaneous expenses at works	.0055
Total operation expense at works	$0.3040
Deduct value of residuals made	.0708
Net operation expense at works	$0.2932
Maintenance and repairs at works	.0198
Total per 1,000 ft. of gas manufactured	$0.3130

The average price of the gas purchased in its crude form was 23.01 cts.; the purification expense, 6.45 cts.; and maintenance and repairs for purifying plant, .49-ct. The foregoing figures have been taken from an audit of the accounts of the company, in accordance with Section 3, Chap. 422, Acts of 1906 of the Massachusetts Legislature, the audit having been made by Harvey Chase & Co., 27 State St., Boston. The full report appeared in the Boston "Post" for Sept. 27. In its letter of transmittal, the auditing company states that it has assured itself of the "adequacy and accuracy of the bookkeeping system" used by the gas company, and also of the fact that the system is faithfully carried out in every detail. In addition, it is of great interest to note, as bearing on the movement for uniform accounts for municipalities and public service companies, that:

> The classifications of the various expense accounts and of the various construction accounts have been continued upon lines which practically coincide with the standard and uniform system now strongly advised for public service corporations and municipal industries throughout the country. The importance of such standard forms, upon which the reports of both municipally-operated and privately-operated public industries can be cast, is so evident to all who are interested in these matters, that further emphasis by us is unnecessary.

THE DAILY CONSUMPTION OF WATER at Halifax, N. S., according to a recent report on water-works conditions in that city by Mr. Willis Chipman, M. Am. Soc. C. E., of Toronto, Ont., is 262 [Imp.?] gals. per capita and 310 gals. per consumer. These figures are based on limited observations made by means of Venturi meters on the three mains delivering the supply to the city. Mr. Chipman was called in to make a thorough investigation of the water-works of the city and needed improvements therein, with the idea, apparently, of expending considerable money for a supplementary supply. He has found that:

> The supply would be ample for all the requirements of the city if efficient means were taken to curtail waste.
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> Of the 11,000,000 gals. [presumably imperial gallons are intended throughout] of water conveyed to the city, about 3,000,000 gals. represents legitimate consumption; 4,000,000 gals., leakage from mains and services; 2,000,000 gals., leakage from plumbing fixtures, 2,000,000 gals., careless waste by householders.
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> The leakage from the mains and services may be considered as not immediately controllable, due largely to the fact that in the oldest parts of the system, and the lowest parts of the city, the mains are jointed with wooden staves. As the old mains are replaced by new pipes this leakage will decrease.
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> Defective plumbing is responsible for a large percentage of the uncontrollable waste. For 50 years after the construction of the original water-works system the plumbing in the city was not regulated by by-law. The plumbing by-law passed in 1896 should be revised, brought up to date, and made retroactive.
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> Relatively minor improvements besides the installation of meters are recommended, chief of which are the installation of a large-capacity pump for fire protection on one of the conduits, and the erection of a water-tower to equalize the pressure in the high-level district. We are informed that in accordance with a recommendation of Mr. Chipman the city has already ordered several thousand meters.

A NEW METHOD OF TUBE WELDING, for iron and steel tubes, is reported by Consul Albert Halstead, from Birmingham, England. The process, patented by two Americans employed in a plant there, is applicable to both butt and lap welding. It consists of directing a current of air and gas aginst the edges to be welded; the effect of this current, upon the metal being drawn through the furnace at what is already welding heat, is greatly to increase the temperature of the edges and thus to facilitate the weld. Cast-iron arms are placed on each side of the furnace, in each of which is a slot 18 ins. long and 3-16 in. wide; by means of supports the metal to be welded is held in front of these slots; and through them is forced the air, by means of ordinary rotary blowers. The blast, besides increasing the temperature of the metal, cleans the edges and thus additionally assists in making a perfect weld.

PERSONALS.

Mr. Jean Prevost has resigned as Minister of Agriculture and Mines of the Province of Quebec.

Mr. L. P. Hoster, President of the Columbus Structural Steel Co., of Columbus, Ohio, has resigned.

Mr. F. M. Collins has resigned as Superintendent of the Lestershire (N. Y.) Water-Works, and is succeeded by Mr. W. D. Smith.

Mr. Alvin B. Carpenter, M. Am. Inst. M. E., of the firm of Carpenter & Brennan, Mining Engineers, of Mexico City, is opening a branch office of that firm at Los Angeles.

Mr. Thomas Fleming, Jr., formerly of the American Water-Works & Guaranty Co., has been appointed Chief of Design of the Engineering Division, Pennsylvania State Department of Health.

Mr. Everett E. Stone, M. Am. Soc. C. E., Assistant Chief Engineer of the Boston & Albany R. R., has been appointed Engineer of Maintenance of Way and Construction, with offices at Springfield, Mass.

Mr. A. Morrill, for 25 years Superintendent of the Salem (Mass.) Electric Lighting Co., has been appointed Assistant to the General Manager. Mr. Harry Kingsley, Assistant Superintendent, has been made Superintendent.

Mr. Samuel Cheatham, Supervisor of Bridges and Buildings on the Mobile & Ohio R. R., has been promoted to the position of Roadmaster of the St. Louis division, with office at Murphysboro, Ill. He succeeds Mr. E. P. Hawkins.

Mr. R. S. Clemons, formerly Manager of the Engineering Department of Dodge & Day, of Philadelphia, has become associated with the Ley Construction Co. as Southern Manager, in charge of all of that company's business south of Baltimore.

Mr. J. M. Floesch, M. Am. Soc. C. E., Chief Engineer of the Buffalo, Rochester & Pittsburg, has resigned and will become associated with the construction company which is doing the greater portion of new construction on the Grand Trunk Pacific Ry. in Canada.

Dr. Gustave Fernekes, late of the Michigan School of Mines at Houghton, has been made instructor in analytical chemistry at the Carnegie Institute, Pittsburg. Mr. K. K. Stevens, Chief Chemist of the Toledo Furnace Co., of Toledo, has been made Instructor in Elementary Chemistry.

Mr. Franklin B. Ware, of New York City, has been appointed State Architect by Gov. Hughes, to fill the vacancy made by the death of George Lewis Heins. Mr. Ware graduated from the architectural course at Columbia University in 1894, then entering the office of his father, and becoming a member in 1896 of the firm of J. E. Ware & Sons. He is a member of the American Institute.

Mr. C. C. Barrett, Division Superintendent over the western division of canals, State of New York, has been appointed Superintendent of the middle division, to succeed Mr. Thomas Wheeler, whose resignation will take effect Oct. 15. Mr. Oscar H. Peacock, an inspector, has been appointed to succeed Mr. Barrett. Mr. Wheeler resigned to accept the Republican nomination for Mayor of Utica.

Mr. F. A. Molitor, M. Am. Soc. C. E., has returned to the United States after a year's absence in the Philippine Islands as Supervising Railway Expert for the Government. Mr. Molitor resigned from that position in April last, since which time he has been making a study of European railway methods and construction; during the summer he visited the principal countries of Europe for that purpose.

Obituary.

Jonathan Wainwright, President of the Drake-Stratton Co., Contractors, died on Oct. 11 at Ogdensburg, N. Y.

J. Norman Cook, a supervising architect with the firm of Egerton Swartwout, New York City, died on Oct. 15 at Somerville, N. J.

A. T. McDonald, Superintendent of the Savage, Belcher, Chollar, Sierra Nevada and Union Consolidated mines on the famous Comstock lode, died during the past week. Mr. McDonald was one of the old-time mining men of the Pacific Coast, and was associated with Messrs. Mackay, Fair and Flood in the former days of the Comstock.

G. Norman Weaver, a well-known water-works and civil engineer of New England, died on Oct. 4 in Newport, R. I., at the age of 57. Mr. Weaver was Secretary and a Director of the Newport Water-Works, and its Consulting Engineer as well. He was educated at the Rensselaer Polytechnic Institute, and for a time was employed by the U. S. Engineer Department. Besides the Newport works, he was also engaged in the construction of those of other towns, including Salem, Lynn, Beverly, and Gloucester, Mass.; Hoosic Falls and Seneca Falls, N. Y.; and Waukesha and Green Bay, Wis.

ENGINEERING SOCIETIES.

COMING MEETINGS.

AMERICAN ELECTROCHEMICAL SOCIETY.
Oct. 17-19. Annual fall meeting at New York City. Secy., Prof. J. W. Richards, Bethlehem, Pa.

NATIONAL RAILWAY WATER SUPPLY ASSOCIATION.
Oct. 22-23. Annual meeting at Beloit, Wis. Secy., F. W. Hayden, Glencoe, Minn.

AMERICAN PEAT ASSOCIATION.
Oct. 23-26. Convention for organization at Jamestown Exposition. Address Julius Bordollo, Kingsbridge, New York City.

ROADMASTERS' AND MAINTENANCE OF WAY ASSOCIATION.
Nov. 11-14. Twenty-fifth annual convention at Chicago. Secy., W. E. Emery, C. & A. Ry., Kansas City, Mo.

AMERICAN MINING CONGRESS.
Nov. 11-16. Tenth annual convention at Joplin, Mo. Secy., J. F. Calbreath, Jr., Denver.

AMERICAN CIVIC ASSOCIATION.
NATIONAL MUNICIPAL LEAGUE.
Nov. 19-21. Joint convention at Providence, R. I. Secy., Clinton R. Woodruff, North American Building, Philadelphia.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.
Nov. 22-23. Annual meeting at New York City. Secy., W. J. Baxter, 29 West 39th St., New York City.

SOCIETY FOR THE PROMOTION OF INDUSTRIAL EDUCATION.
Dec. 5-7. Convention at Chicago. Secy., C. R. Richards, Columbia University, New York City.

PITTSBURG FOUNDRYMEN'S ASSOCIATION.—The annual meeting was held on the evening of Oct. 7, at the Hotel Henry, Pittsburg. Mr. Jas. Scott, of the Isabella furnaces of the Carnegie Steel Co., and Mr. C. W. Mason, of the Midland Steel Co., spoke on "Uniformity and Modern Ideas in Making Pig Iron." Officers elected for the ensuing year were: President, Herbert E. Field, Metallurgical Engineer of MacIntosh, Hemphill & Co.; Vice-President, Elliot A. Kebler; Secretary, F. H. Zimmers, Union Foundry & Machine Co.; Treasurer, Jos. S. Seaman.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—At the next regular monthly meeting at 29 West 39th St., on Nov. 12 at 8.15 p .m., the principal address will be one by Mr. Charles R. Pratt, M. Am. Soc. M. E., treating of features of construction and operation of the positively-controlled, high-speed electric traction elevator which is described on p. 346 of Engineering News for Sept. 26, and which is to be installed in the Singer and Metropolitan Life Insurance buildings, New York City. Engineers and architects of New York, Chicago and Philadelphia are expected to discuss the new elevator.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—At the first regular meeting of this season, on Friday, Oct. 11, Mr. Paul M. Lincoln, of the Westinghouse Electric & Manufacturing Co., presented a paper on "The Grounded Neutral, With and Without Series Resistance, in High Tension Systems." This paper dealt with the advantages, disadvantages and methods of grounding the neutral point of three-phase generating and transmitting systems. Mr. F. G. Clark, Superintendent of Power Stations of the Pennsylvania Tunnel & Terminal Railroad Co., and Mr. G. I. Rhodes, Assistant Engineer of the Interborough Rapid Transit Co., of New York, presented papers on experience and results of grounding the neutral point of high tension systems. The discussion was mainly on the experience with grounded neutrals in some of the larger installations of the country. Part in the discussion was taken by Messrs. P. Junkersfeld, Assistant Mechanical Engineer, Chicago Edison Co.; O. S. Lyford, Jr., Electrical Engineer, Westinghouse, Church, Kerr & Co., and Phillip Torchio, Chief Electrical Engineer, New York Edison Co. Throughout the meeting the idea was shown that the benefits and disadvantages of this practice depended largely on local conditions.

ENGINEERING LITERATURE

Supplement to ENGINEERING NEWS. October 17, 1907.

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REVIEWS.

History of the Erie Canal.

STATE ENGINEER AND SURVEYOR (New York).—Annual Report for the Fiscal Year Ending Sept. 30, 1905. (Henry A. Van Alstyne, State Engineer and Surveyor.) In three volumes. Albany, N. Y.: Pub. Doc. Cloth; 5½ × 9¼ ins.

Main Report: Pp. 775; folding and other plates, and map in pocket.

Supplement: History of the Canal System of the State of New York, Together with Brief Histories of the Canals of the United States and Canada. (Two volumes.) By Noble E. Whitford, Assoc. M. Am. Soc. C. E., Resident Engineer, State Engineer's Department. Pp. 1,547; folding and other plates, and text figures; map and diagram in pocket.

The routine portion of this report of the State Engineer of New York has been delayed too long to be of much importance except to the engineers interested in the barge canal work or to the citizens immediately concerned in public improvements. However, the supplementary two volumes by Mr. Noble E. Whitford, Assoc. M. Am. Soc. C. E., on the History of the Canal System of the State are of so unique an interest that it seems fitting that the attention of the profession should be called to their value.

The recent journey of the President and State governors in semi-triumphal procession down the Mississippi, together with the meeting of the Deep Waterways Convention at Memphis and the presidential speeches there, have once more commanded the attention of the people to the possible utility of inland water navigation. The enthusiasm aroused throughout the Middle West by the proposed canalization of the gulf-to-lake streams, in these days of networked railway systems crossing and recrossing the country and penetrating to its most remote parts, calls to mind a similar enthusiasm of the early days of the nation when, under the most primitive modes of transportation by naturally available rivers or more or less impassable roads, the artificial water channel seemed to point the way to commercial prosperity. The petitions and demands for the gulf-to-lakes navigation route find their counterpart in the political and financial struggles of a quarter century which culminated in that first of our great man-made waterways, the Erie Canal. The digging of a 400-mile canal was in that day a monumental construction; the financing of a $11,000,000 project was a matter for long discussion and naturally the Erie Canal became a national topic. The whole history of New York State and the early history of the United States is woven into the construction of this canal and its numerous successors which were built once the project had proved successful. In addition to its political significance, it marks the beginning of engineering in the United States, for in the building of its first prism the first real engineers in this country were developed.

Many studies of the history of the Erie Canal have been made, but they have mostly been from fragmentary sources and of such nature as would be necessary for a chapter in a general history and in no way complete enough to furnish a basis of knowledge of value both to the historian and to the engineer. The decision of the State Engineer's office, then, to make a complete and thorough study of the canal systems of the State, while primarily intended to furnish information for official use, should be praised not only by engineers but by all interested in the economic and historical development of the country. The task set to Mr. Whitford was enormous; these canals have been a source of constant legislation since the latter part of the 18th century, for a large part of that time they have been under discussion in the public prints and the fair mark for voluminous pamphleteers. To attempt a rational abstract of this mass of accumulated material so as to present the subject in a manner not purely chronological nor statistical, but interesting as well as instructive, would seem to be open only to the talents of a trained historian. That a practicing engineer should have completed this work in so admirable a manner is to the credit of the profession.

The work is in two parts, the first an historical account of the entire canal system of the State of New York from the first work done at Little Falls, in 1793, on what later was to become the Erie Canal, to the start of the $101,000,000 barge canal in 1905; the second is a statistical account of the canals, together with biographical and bibliographical notices.

The historical study of the canals of New York is a study of the Erie Canal, for upon the success or failure of that the future development of the system depended. As Mr. Whitford points out, the progress of canal building in this country is divided into three stages: (1) the canal as a novel and chief method of transportation; (2) the original canals, enlarged to meet the growing competition of the railways which gradually overcame the canals and nearly reduced them to uselessness; and (3) the old canals, rebuilt and enlarged and placed on a modern basis so that they could successfully compete with the railways and reduce their too-powerful influence on the commerce of the country. The first stage in New York State lasted until 1834, when the first enlargement of the Erie was proposed; the second lasted until 1884, when the new barge canal was first projected, and the third is now well progressed with the construction of the barge canal.

All through the eighteenth century the commercial interests, alive to the possibilities of the great fertile country in the northern part of the state, were studying the feasibility of connecting the interior lakes and rivers so as to make an easy transportation down the Hudson to the sea, and to this end the very meager engineering ability of the day was directed. The first attempt at an extended line was the incorporation of a State-aided company, in 1792, to build a canal from the Hudson to Lake Ontario. This company proceeded slowly on the work and in 1796 opened a 16-ton canal from Schenectady to Seneca Falls. Although helped again by the State with repeated extensions in time for the completion of the work, this company never finished its line, and in 1800, or thereabouts, the first suggestions were made for a canal from the Hudson River to Lake Erie. To whom the honor of the first suggestion is due, is doubtful. Many men at this time were struck with the value of the scheme and vigorously advocated it in press and Legislature. It was fought out on the floor of the federal Congress, but the representatives of the states not immediately affected could not be brought to see its value. Finally, the State of New York, failing to enlist the aid of even the States of the Western Reserve and of New England, passed a bill in 1816 which authorized the Erie Canal, to be built entirely by the state, the funds to be secured principally from tolls, with an additional taxation on the lands contiguous to its line.

The work was started on July 4, 1817, at Rome. It was completed in 1825, and on October 26 of that year a triumphal parade of boats was made carrying the waters of Lake Erie to be poured with appropriate pomp and ceremony into the Atlantic Ocean at New York City.

The portion of Mr. Whitford's book dealing with this first construction, is particularly instructive as a history of early engineering in the United States. Although many previous canals had been built, they were all in charge of English or other foreign engineers. In fact, there were no Americans who could properly be called engineers, much less any who presumably could superintend the construction of so large a work of an entirely pioneer nature. In spite of the fact that William Weston, an English engineer who had prepared the larger part of the surveys of this route, was offered the then enormous salary of $7,000 a year, his ill health and age prevented his acceptance and the superintendence of the work was turned over to James Geddes and Benjamin Wright, two American lawyer-surveyors, a curious but common combination of the time. Under their direction, and with the able assistance of other Americans whose names have come down as great engineers of their time, such men as Canvass White and Squire Whipple, the work was carried to a successful completion by American brains; the first of the large monuments to American engineering genius. Here also the contractor on public works, at least on a large scale, appears for the first time, and the naive manner in which the State advanced moneys to the insolvent contractor to enable him to carry on his work, seems strange to modern minds. In 1818, Canvass White made what was possibly the first hydraulic cement ever manufactured in this country. This cement, made from a rock in Madison county, was afterwards used extensively on the canal work. In view of the fight against disease in some of our modern canals, it is interesting to note that from the middle of July to October, 1819, an epidemic of fever incapacitated over 1,000 laborers on the marshy sections near Cayuga Lake. These are but a few of the details of that early work which should interest every American engineer.

The canal rapidly proved its value. In 1834 its use had extended to such proportions that tolls were reduced and a suggestion made to the legislature that its prism be increased from its original 40-ft. top width and 4-ft. depth, to a 70-ft. width and a 7-ft. depth. This increase was soon started, although not completed for a number of years. Meanwhile the success of the Erie had incited both private capital and legislative action to the building of further canals. This building proceeded without regard to the availability of the country opened or the liability of profitable investment so that, with the ever increasing competition of the railways, much money was lost and the value of the canals reduced. So great in fact was this railway competition that at one time a bill was introduced into the legislature —and favorably considered though not passed— turning the bed of the Erie Canal into a railway right-of-way.

In about 1884 the public began to see that in order to curb the power of the rate-making railways it was absolutely necessary to provide a suitable waterway through the State. The slow-working legislative action with its compelling public opinion did not bring this about until 1905, although in 1895 the depth of the Erie was increased to nine ft.

Such is a brief résumé of the history of the New York canal system as given in Mr. Whitford's comprehensive work. In addition, he gives a full statistical tabulation of its financial history and detailed accounts of the specific engineering works; biographies of all its living engineers who had reached the rank of assistant engineer prior

to 1882 and of all the important heads of works who have since died. There are also included three admirable little essays on the Abandonment of the Lateral Canals, the Canals as a School of Engineering and the Economic Influence of the Erie Canal. Appended to the second volume is a very complete bibliography of the New York canals and extracts from federal government reports on the various canals of the world and a short descriptive account of the canals of the United States.

Mr. Whitford is to be congratulated on his work. With the accurate knowledge of the engineer and the discriminating skill of the historian he has presented an absorbing description of a great work, the story of construction under difficulties unknown to-day, of political intrigue involving the greatest men of our young nation, in one case at least affecting the well-founded presidential aspirations of a governor of New York. It is a good book for the engineer's leisure hours.

British Boilers.

Reviewed by WILLIAM KENT,* M. Am. Soc. M. E.

STEAM BOILERS AND SUPPLEMENTARY APPLIANCES.—A Practical Treatise on Their Construction, Equipment and Working. By William H. Fowler, M. Inst. C. E., M. Inst. M. E., etc. Manchester, England: The Scientific Publishing Co. Cloth; 5½ × 8⅝ ins.; pp. 619; 572 illustrations in the text. 12s. 6d., net; American price, $5, net.

The author of this book states in his preface that there is a want of a book on boilers and supplementary appliances suitable to the needs of the steam user, the works manager, the boiler inspector and the attendant in charge. There may be such a want in England, but it is not a serious one in this country, for quite a number of books on boilers have been published here within the past ten years. The book does not differ materially from others of its class, but it is largely devoted to English types of boilers which are but little known in this country.

The first chapter treats of materials of construction, the second of the strength of boilers; then follow several chapters on Lancashire and Cornish boilers, vertical, locomotive, externally fired, marine and water tube boilers. These chapters occupy 165 pages of the book and contain 140 illustrations. A great number of the boilers are of strictly English types and will have little interest to American readers except as curiosities. The number of different ways in which the Englishman has learned to build a vertical internally-fired boiler is really remarkable. A description of the Vanderbilt locomotive boiler is given and it is said to be one that is rather extensively adopted on American railways. This will be news to American locomotive engineers.

Chapters follow on domestic hot water boilers and boiler appliances, such as steam valves, safety valves, feed, blow-out and scum valves, water gages, alarms, fusible plugs, steam pipe arrangements, steam traps, reducing valves, steam pumps and indicators, feed-water heaters, evaporators, apparatus for filtering and softening feed water and superheaters. This portion of the book occupies over 200 pages and is chiefly "catalog matter." It is illustrated with 124 cuts, most of them reproductions of line drawings, which are better than the half tone cuts with which most of our recent American books are disfigured.

A chapter of 25 pages follows on fuel and combustion, then two chapters on boiler furnaces and mechanical stokers. These chapters are also descriptive and well illustrated. Chimney draft is treated in a brief chapter which includes descriptions of Howden's and Ellis & Eaves' systems of forced draft. The chapter on Use of Oil as Fuel in Steam Boilers contains a great number of cuts of oil burners and diagrams of oil furnaces. The tests of the U. S. Naval Liquid Fuel Board, a few years ago, are briefly referred to, but the results of these tests are not given. Non-conducting covering for steam pipes covers 5 pages and corrosion in boilers 20 pages. The chapter on corrosion is well illustrated. Defects in boilers are treated in a brief illustrated chapter, and hydraulic tests are described. The standard form of reporting a boiler test proposed by the Institution of Civil Engineers is given, which is very similar to the standard form of the American Society of Mechanical Engineers.

In regard to starting and stopping the trials, three methods are given instead of the two called Standard and Alternate in the American code. The first of the British methods is the one commonly called "the flying start and stop" in America, which is no generally approved. The second method is somewhat novel and briefly stated is as follows: the boiler being in good order and regular operation, firing of the boiler is stopped about a quarter of an hour before the time fixed for the start. The fire is examined carefully from time to time and raked off to close in holes. The pressure gage is watched until at a fairly distinct moment pressure begins to drop rapidly. This instant is noted at the beginning of the trial. The feed pumps are then stopped and the height of the water in the gage glass noted and the ashes are cleaned out. Stoking is recommenced and the feed pumps are again started. Near the end of the trial, after the last firing of coal, the steam gage is again carefully watched and the instant at which it begins to show a notable fall is taken as the time of the finish of the trial. The method thus described may be a good one where there is only one boiler in use, but where a boiler is connected to a steam engine, the pressure in which is kept up by other boilers, it would appear not to be applicable. The third method is similar to the American alternate method, except that the beginning of the trial is after the "fires are made up and burnt through," instead of the instant of firing the first coal as in America. In the writer's opinion this is not as good a plan as the American alternate method.

The final chapter of the book is on boiler inspections and boiler inspecting and consists chiefly of directions to boiler inspectors.

On the whole, the book may be considered a useful work of reference for those interested in the subject, but it will not take the place of any of the standard American works.

*Dean of College of Applied Science and Professor of Mechanical Engineering, Syracuse University, Syracuse, N. Y.

ON THE ART OF CUTTING METALS.—By F. W. Taylor. An Address Made at the Opening of the Annual Meeting in New York, December, 1906. New York: The American Society of Mechanical Engineers. Cloth; 6 × 9¼ ins.; pp. 248; 24 folding plates. $3.

The epoch-making work of Mr. F. W. Taylor, "The Art of Cutting Metals," which formed his Presidential Address to the American Society of Mechanical Engineers last December, has now been published in the form of a separate book by that Society. There is a distinct propriety in this form of publication: The masterly monograph is in no sense a mere paper or address, but a treatise, a voluminous and thorough record of a pioneer research in a difficult field, and to leave such a work buried in the Transactions of a society seems quite inappropriate to its importance. The separate publication is more fitting. Moreover, the work is undoubtedly made accessible to wider circles of readers and users, in this form. The make-up of the book is creditable; typography and illustrations are clear and pleasing, and the binding is substantial. Less pleasing is the survival of a number of typographical errors, particularly in the references to the many folding plates. More thorough work in editing the text, before the issue of this separate volume, would have been distinctly advantageous.

STEREOTOMY.—By Arthur Willard French, M. Am. Soc. C. E., Professor of Civil Engineering, Worcester Polytechnic Institute, and Howard Chapin Ives, Assistant Professor of Civil Engineering, University of Pennsylvania. Second Edition. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 5¾ × 9¼ ins.; pp. 119; 47 illustrations, mostly in the text, and 22 folding plates. $2.50.

The review of the first edition of this work, printed in our issue of Jan. 15, 1903, will serve without change for the present or second edition. The book remains a well-written compilation of method and example in stone-cutting, and is serviceable alike for self-study and for use in the class-room. While no great variety of the more intricate problems is presented, yet the applicable methods are sufficiently illustrated that the student should be able to extend them to any more elaborate problem. The work of revision in preparing this edition has not been very extensive. Some minor lapses were overlooked, and the term "oscillatory" circle for "osculatory" on p. 56 appears to be a new addition. The authors are to be commended for championing the term "soffit" in place of "intrados," meaning the concave surface of the arch-barrel. Instead of dropping the term "intrados," they define it as the line of intersection between soffit and face. This definition later leads to trouble, as on p. 81 they say that in one form of skew arch the intrados (a line) is a warped *surface*, a definition which is not cleared up by reference to the subsequent detailed description of the arch in question.

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DETAILS OF MILL CONSTRUCTION.—By Hawley Winchester Morton, Architect. Boston, Mass.: Bates & Guild Co. Cloth; 9½ × 12½ ins.; 25 plates. $2.

In a series of 25 plates, the author attempts, with only partial success, to present a complete set of structural details of "mill construction" factories. The large scale of the drawings and lettering, necessitated by their "architectural" execution, makes the amount of matter contained on these 25 plates far less than the same space could readily accommodate with an execution better suited for printed reproduction. There is in consequence practically no variety offered in the several details. In most of the details shown, however, it would have been of far greater value if several different types had been shown side by side. This applies to the framing details quite as much as to the door, window and cast-iron details. However, the collection has value if only in a suggestive way; and if the user of the album considers this or that detail inferior, awkward, or incomplete, he will at least have before him a picture of what type of detail to avoid.

HENDRICKS' COMMERCIAL REGISTER OF THE UNITED STATES.—16th Annual Edition. New York: Samuel E. Hendricks Co. Cloth; 7¼ × 10½ ins.; pp. lxxvi. + 1224. $10.

This may perhaps be truly described as a monumental work, although monuments in general are not renewed yearly and are not continually increasing in size. The present volume contains some 350,000 names and addresses, classified under about 31,000 trade headings. The first edition, published some 15 years ago, dealt with the building industries only, but the present one covers engineering, mechanical, railroad, electrical and mining, iron, steel, export, agriculture, and a variety of other interests. A content index of 76 pages makes it easy to locate almost any article desired, whether abattoir scales, oscillographs, ox shoes, Rosendale cements, wrenches or zinc wire. Many important subjects, having numerous references, are classified by States.

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G. A. CHRISTENSEN, Civil Engineer

72 San Pablo Avenue, Oakland, California

The Parsons Marine Steam Turbine.

Reviewed by D. W. TAYLOR.*

THE MARINE STEAM TURBINE.—A Practical Description of the Parsons Marine Turbine. By J. W. Sothern, Member Institute of Engineers and Shipbuilders in Scotland, Principal Sotnern's Marine Engineering College, Glasgow. Second Edition. New York: D. Van Nostrand Co. London, England: Whittaker & Co. Cloth; 5½ × 8½ ins.; pp. 163; folding and other plates, and text illustrations. $2.50, net.

This book is devoted entirely to the Parsons marine steam turbine, the application of other types of turbine to marine work being ignored. It contains 163 pages in all, of which 31 pages are devoted to elementary thermodynamics and theory of turbine action, 67 pages to description of the Parsons turbine, methods of installation, and so forth, 60 pages to results obtained in service and discussion of the same, 9 pages to elementary problems in turbine design and their answers, and 5 pages to an index.

The theoretical portion is rather inadequate. The portion descriptive of the Parsons turbine gives an excellent general idea of its construction and installation for marine use, and is generally quite complete, although the fact that the figures and diagrams are not numbered is a drawback.

Although devoting a good deal of space to the question of blade tip clearance, the author has omitted reference to the device of thinning the blade tips for a short distance, so that in case of contact wtih the surrounding casing they will wear down and not strip. This device has been used on a number of Parsons turbine installations for marine purposes.

The portion of the book dealing with results brings together much information upon various installations, most of which has been previously published. While, as to be expected, the author favors turbines, he frankly states that up to the present time deep-sea turbine steamers have not been able to compare very favorably with the ordinary engine in the matter of coal consumption, although he claims superior economy for river or channel service and certain men-of-war. The author points out the fact that the difficulty of obtaining propellers which will give high efficiency for high revolutions and thrust per square inch of projected area is the great obstacle in the way of the successful application of the turbine to marine work; but he does not indicate any solution of the difficulty. In this connection, it may be noted that twice the statement is made that the efficiency of a screw is equal to 1—the slip. Were this the case the problem of the propeller for turbines would be readily solved.

Liberal extracts from a paper on turbine construction by Mr. E. M. Speakman constitute by no means the least valuable portion of the book, and arrangement of the text, seem to be such as by the author's original matter in a somewhat different manner.

The press work is excellent, and very few typographical errors appear. On page 25 "Entrophy" evidently means "Entropy," and in the diagram facing page 72 the reverse turbine is designated "reserve" turbine.

The book is principally of value for the adequate idea it conveys of the details of construction and installation of the Parsons marine turbine in 1906.

*Naval Constructor, U. S. N., U. S. Navy Yard, Washington, D. C.

DAS MATERIAL UND DIE STATISCHE BERECHNUNG DER EISENBETONBAUTEN.—With Special Reference to Building Construction. By Max Foerster, Professor of Structural Engineering at the Dresden Technical College. [Fortschritte der Ingenieurwissenschaften, Second Series, Part 13.] Leipzig, Germany: Wilhelm Engelmann. Paper; 7¼ × 11 ins.; pp. 248; 93 illustrations in the text. 6 marks; American price, $2.40.

This addition to the rapidly growing number of German text-books, treatises and handbooks of reinforced concrete deals only with the material, its strength and its calculation, leaving out from consideration the field of actual application. The subject of strength is handled by reviewing the German and French reports of tests and experimental researches. The theoretical work from which the formulas for calculation are developed seems conservative rather than marked by specific novelty or by distinct individuality. The nature of the contents of the book, and the style and arrangement of the text, seem to be such as to make more appeal to the foreign than the American reader.

WATERPROOFING.—A Monthly Journal of Progress in Waterproofing Engineering. Myron H. Lewis, C. E., Editor and Publisher (8-10 Burling Slip, New York). Vol. I., Nos. 1 and 2, July and August, 1907. Paper; 7¾ × 10¼ ins.; pp. 1 to 16 and 17 to 32, respectively. $1 per year; 10 cts. per copy.

The editor of this new journal says:

We shall devote the columns of this journal to an intimate study of the injurious action of water; to the advancement of sanitary, economical and durable construction; to the discussion of the causes that lead to decay, corrosion, disintegration, and disfigurement of materials and structures; to the methods of prevention to be adopted against these ravages, and to all other matters included in the broad term of "waterproofing."

This is indeed a very worthy field for discussion and providing that the information to be exploited does not become exhausted or the space wasted in vain repetition—the two dangers of so limited a topic—the paper should become very useful. The dangerous effects of unrestrained water needs no exposition; it is the bugbear of most engineering work. That such evil effects have been but ineffectually combated is equally as well known, and any regular record of the progress of such work as is being done will help the perfecting of the art. The articles presented in the two numbers of the journal which have been issued have admirably followed the intentions noted in its introduction; the only criticism to be made is that they claim, as a rule, a too universal application of the various commercial processes now on the market, an unpleasant resemblance to the sovereign cure-all virtues of certain patent medicines. The vigor of the editorial attack on a statement of the Waterproofing Committee of the American Society for Testing Materials to the effect that concrete, not treated with some external wash or internal mixture, may be watertight if properly made, has the sound of too much protesting, though it may only be a defense of the journal's reason for being. However, it is well for a newcomer in the journalistic field to remember that an impartial attitude is the only safeguard of the technical press.

DIE HERSTELLUNG DER DAMPFKESSEL.—By M. Gerbel. Berlin, Germany: Julius Springer. Paper; 5⅛ × 8¼ ins.; pp. 82; 60 illustrations in the text. 2 marks; American price, 80 cts.

The author describes the successive stages in the manufacture of a steam-boiler very succinctly. His aim, it would seem, is to teach the prospective purchaser or user, or the general reader. To this end he describes the mechanical processes, their principle causes of variation or difficulty, and their effects on the quality of material or usefulness. In the small compass of 82 pp. he has brought together a large amount of excellent, well written information.

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Four British Electrical Books.

Reviewed by HENRY H. NORRIS.*

ELEMENTS OF ELECTRIC TRACTION FOR MOTORMEN AND OTHERS.—By L. W. Gant, Lecturer in the Electrical Engineering Department of the Leeds Institute Technical School. New York: D. Van Nostrand Co. Cloth; 5⅛ x 8¼ ins.; pp. 217; 38 illustrations in the text. $2.50, net.

ELECTRICITY IN MINING.—By Sydney F. Walker, M. Inst. E. E., M. Inst. Min. E., Assoc. M. Inst. C. E., etc. New York: D. Van Nostrand Co. Cloth; 5⅛ x 8¾ ins.; pp. 385; 31 plates and 163 text illustrations. $3.50, net.

LABORATORY WORK IN ELECTRICAL ENGINEERING.—(Preliminary Grade.) A Series of Laboratory Experiments for First and Second Year Students of Electrical Engineering. By John Roberts, Jr., Diplomate in Electrical Engineering, School of Technology, Manchester; Lecturer in Engineering, Municipal Technical School, Blackburn. New York: D. Van Nostrand Co. Cloth; 5½ x 8¾ ins.; pp. 218; 108 illustrations in the text and 14 tables. $2, net.

THE CONSTRUCTION OF DYNAMOS.—(Alternating and Direct-Current.) A Text-Book for Students, Engineer-Constructors, and Electricians-in-Charge. By Tyson Sewell, Assoc. M. Inst. E. E., Lecturer and Demonstrator in Electrical Engineering at the Polytechnic, Regent St., London; Author of "Elements of Electrical Engineering." New York: D. Van Nostrand Co. London, England: Crosby Lockwood & Son. Cloth; 5¼ x 8¼ ins.; pp. 316; 233 illustrations in the text. $3, net.

Technical writers in Great Britain have been for the past few years producing excellent books, particularly in the line of Electrical Engineering. Among those recently reviewed in these columns are Parshall & Hobart's Electric Railway Engineering, Lamb's Alternating Currents, Hay's Alternating Currents, and Hobart's Dynamo Design. These books all show that the writers appreciate the needs of the technical reading public, and that they are catering successfully to this need.

Mr. Gant's book is addressed particularly to motormen, and had its origin in a series of lectures recently delivered to a class of practical men. His book is not a handbook, such as have been prepared by several writers, largely to enable motormen to perform their duties satisfactorily. As the name indicates, the book is intended as an introduction to the more advanced works on the same subject. A large part is occupied with a treatment of the underlying principles of electricity and magnetism, of the continuous-current generator and motor and of the mechanics of car operation. Passing over the material dealing with the elementary principles, which differs from that usually found in elementary books only in that it is very much condensed and that it is elaborately illustrated with numerical examples, attention may be directed to the sections devoted to traction. A chapter is devoted to the application of motors to traction purposes. The characteristics of the motors as applied to car driving are clearly described. Unusual space is given to special systems, particularly those designed to return power to the line on down grades. These regenerative systems are not in high favor in this country, but, from the proportion of space given by the author to them, they are apparently attracting attention in England.

A long chapter is devoted to braking, and here again the less usual forms of brake are elaborately described. The mechanics of braking, as well as of acceleration, are given proper attention, and are illustrated by numerous simple and practically numerically solved problems.

The treatment throughout the book is nonmathematical, elementary arithmetic being the only branch of mathematics necessary in following it. The style is readable and as clear as could be expected in view of the limited space, the large range of topics, and the presumably meager preparation of the readers. To an observant motorman the book would be probably very interesting, and it should also be helpful to others who have not had the advantage of studying mechanics and elementary electrical engineering. The book lacks attractive illustrations. While there are a number of diagrams, there are no pictures such as are usually found in a book of this character. In this respect it differs radically from Ashe & Kelley's Electric Railways, which is somewhat similar in purpose, although not designed particularly for motormen. It might serve as a preparation for reading such books as Herrick & Boynton's American Electric Railway Practice, the Electric Railway papers presented at the International Electrical Congress of 1904 and such works.

*Professor of Electrical Engineering, Cornell University, Ithaca, N. Y.

The application of electricity to mining has been treated exhaustively by Mr. S. F. Walker. He has been engaged for 30 years in practically adapting electricity to mining work. In the preface he states that for a time he met with great opposition, but he realized that in the end practical mine engineers and managers would appreciate the possibilities of electric drives for various purposes. This has now come about, and electricity is applied almost as largely in mining as in other branches of practical engineering.

Mr. Walker's book has been addressed directly to practical mine operators and engineers, and he has endeavored to present in a reasonable compass the necessary theory and the manner in which it is applied. He has included as much electrical and mechanical engineering as he considers necessary for the mining engineer. This material has been given in a practically nonmathematical manner. The electrical engineer reading this book will be interested to note that practically every line of electrical engineering development has been incorporated into mine work. These include lighting, signals and telephones, and various motor applications, with the necessary power plants for producing the current. The book impresses any one with its practical viewpoint. The author evidently knows what is needed in mines as well as what has been found of practical utility.

The short introductory chapter contains modern views of electricity, and a simple explanation of the quantities which are in every-day use. This is followed by a discussion of electric mining signals, and the best methods of installing such systems. The relation of the apparatus to the dangerous location in which it is to be operated is kept constantly before the reader. The chapter on electric lighting is very complete, and covers practically all forms of electric lamp in use at the present time. Nearly one-third of the entire book is devoted to the generation of electricity, and in this all kinds of boilers, engines, and generators are described. The author has a good perspective of this subject, evidently based on long experience, and the many topics are treated in an interesting and helpful way. There is naturally very little reference to mining in this part. A great deal of space is also given to the distribution of electric current, particularly in connection with mines, and many successful types of insulators, switches and other details are given.

One of the most interesting parts of the entire work deals with the driving of machines by electricity. In mine work the electric motor is used for pumping, haulage, winding, coal cutting and head drilling, ventilating, air compressing, and miscellaneous uses. Each of these is given appropriate space, and the descriptions are well illustrated by clear diagrams and pictures. The book closes with a short chapter on faults in electric apparatus, intended to enable the practical engineer to detect and repair simple failures, and to realize the extent of more serious damage. As a whole, the book impresses one as a well balanced, well written, and comprehensive summary of the subject. For those who desire to go farther in the detail of any section it will serve as an excellent introduction. For the operator in daily contact with the apparatus described it will be stimulating and suggestive. It has a good index, and the illustrations are well above the average, especially the half-tones on coated paper.

The Laboratory Manual, by Mr. Roberts, is intended to fill a need not usually met by such books. There is a class of experiments which lie between physics and electrical engineering. These are partly covered in the physical laboratory and partly in the electrical engineering laboratory, but are apt to be neglected by both. There evidently should be somewhere in an engineering course an elementary electrical engineering laboratory. For such this book has been prepared. It contains descriptions of and directions for making a large number of simple experiments with physical and engineering apparatus.

The material divides itself naturally into two general sections, the first dealing with measurements of resistance, electromotive force, current, quantity and energy. The preliminary work leads up naturally to the calibration of instruments. The second part treats of measurements of an engineering nature, such as tests of materials used in electrical machinery, of electric lamps, and of small electrical machines.

The book is one which should find a field of usefulness in high school work, or in the elementary courses in technical or scientific schools. Each ex-

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periment is briefly and systematically arranged with blank forms for tabulating results, and in a few cases with actual experimentally obtained data. The plan of arrangement of the material for each experiment is: (1) Introduction; (2) diagram of connections; (3) list of apparatus required; (4) method of performing the experiment; (5) tabulation of results.

The only criticism of this arrangement is that the student is not directly stimulated to draw deductions from his experiments. This lack can be easily supplied by the personal instruction of the teacher.

The little manual is well printed and bound. It contains in the appendix some useful information on the manufacture of standard cells, and a number of physical and mathematical tables are also included. It has no index, but to partly make up this lack there is a full list of the experiments arranged in the form of a table of contents.

Under the title "Construction of Dynamos" Mr. Sewell has given the standard material on the general underlying physical theory of the subject and its application, in an unconventional style of composition. It is difficult to determine the reason for publishing again what already appears in so many books and in such satisfactory form. The title is misleading, as but a few chapters are devoted to construction, the remainder being on theory and operation. For example, there is a chapter on the capacity of the circuit, although what this has to do with generator construction is difficult to determine. The continued use of the meaningless term "dynamo" is to be deplored, but fortunately it has largely gone out of use in this country. It is an abbreviation for the clumsy expression, "dynamo-electric machine," which has been superceded by "alternator," "a. c. generator," "d. c. generator," "motor-generator" set, etc. The author makes a curious division between bi-polar and multi-polar machines. Bi-polar "dynamo" construction is treated at length and is followed by a chapter on the theory and by another on the design of bi-polar machines. This might lead the inexperienced reader to suppose that there is an essential difference between these and multi-polar generators. The fact is that the two differ in few particulars and if the multi-polar type is properly understood the other will present no difficulties.

The book opens with a short discussion of the principles of direct currents, particularly the relation of current, electromotive force and resistance. Next are the magnetic field and its properties, the production of electromotive force by cutting the field with a conductor, the principles of alternating currents, and similar topics, each with a chapter to itself. Then follow illustrated descriptions of several peculiar-looking bi-polar types. A great deal of good information is given, but there is a lack of perspective, the reader being left in doubt as to what is the standard practice. Most of the information given under "bi-polar dynamo construction" applies equally well to other direct-current generators and a great deal of it also to alternators. The best part of the book is that dealing with the construction and design of multi-polar "dynamos," both direct-current machines and alternators. The half-tones and diagrams are well selected and show modern machines. Numerical examples of design calculations are worked out in detail to illustrate and emphasize the statements made.

THE CANAL RECORD.—Published Weekly under the Authority and Supervision of the Isthmian Canal Commission. Vol. I., No. 1, Sept. 4, 1907. Ancon, Canal Zone, Isthmus of Panama: The Canal Record. Paper; 9½ × 11¾ ins.; pp. 8.

The editor states that:

The primary purpose of "The Canal Record" is the publication of accurate information, based upon official records, concerning all branches of the work of canal construction. So far as practicable, the progress made week by week, month by month, and year by year will be shown in comparative tables of statistics. In addition there will be published such information in regard to the social life of the Zone, its amusements, sports, and other activities, as is thought to be of general interest. Space will also be given to letters from employees relating to any topic upon which they may choose to write, subject only to the restrictions that such communications must be couched in respectful language and must be signed in each instance with the name and address of the writer.

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Industrial Alcohol.—Chemical Reagents.

Reviewed by LEONARD P. KINNICUTT.*

INDUSTRIAL ALCOHOL.—The Production and Use of Alcohol for Industrial Purposes and for Use as an Illuminant and as a Source of Motive Power. By John Geddes M'Intosh, Author of "The Technology of Sugar," etc., Lecturer on Manufacture and Applications of Industrial Alcohol at the Polytechnic, Regent St., London. London, England: Scott, Greenwood & Son. New York: D. Van Nostrand Co. Cloth; 5¼ × 8¾ ins.; pp. 252; 78 illustrations in the text and 25 tables. $3. net.

CHEMICAL REAGENTS.—Their Purity and Tests. A New and Improved Text Based on and Replacing the Latest Edition of Krauch's "Die Prüfung der Chemischen Reagentien auf Reinheit." By E. Merck. Authorized Translation by Henry Schenck, A. B. (Harvard). New York: D. Van Nostrand Co. Cloth; 6 × 9½ ins.; pp. 250. $1.50, net.

The first of these books, after describing the properties of grain, or ethyl, alcohol, and the general principles of fermentation, takes up the manufacture of alcohol from beets, from grain, from potatoes, from spoiled wine, and fruit in general, and from sugar cane and sugar cane molasses, devoting a chapter to each process. A long chapter is given to the description of the various methods of distillation and rectification of the alcohol obtained from the above sources. The concluding chapter gives in more or less detail the uses of grain alcohol in the arts, the principal part being devoted to its action as a solvent. This undoubtedly has been the chief use of alcohol, but it seems to the reviewer that as one of the most interesting questions of the present time is to what extent alcohol can be substituted for petroleum as a fuel, that this topic should have received greater attention and study than is the case. Another criticism that can well be made is that a book on grain alcohol, published in 1907, should have contained a chapter on denatured alcohol.

The book, on the whole, is well written and is carefully indexed. The diagrams are numerous and well chosen. The book serves a useful purpose in bringing together under one head much interesting and valuable information.

"Chemical Reagents" is a translation of the fourth edition of Krauch "Die Prüfung der Chemischen Reagentien auf Reinheit," published in 1905, although the fourth edition of this book was not revised by Krauch himself, but by Dr. Merck.

Krauch's book has always been considered as a most useful book in the chemical laboratory and has undoubtedly done much in causing the manufacturers of chemical reagents to be more careful regarding the purity of their products. This last edition has been carefully revised and is well translated, and has numerous footnotes referring to original articles relating to analytical methods used in the determination of the purity of various reagents.

It is a book that is valuable not only to all who are purchasers of chemical laboratory supplies, but also to the student in chemistry who often regards the letters "C. P." as a sufficient guarantee that the substance after which these letters are placed is beyond suspicion.

*Director Department of Chemistry, Worcester Polytechnic Institute, Worcester, Mass.

THE BUILDING MECHANIC'S READY REFERENCE.—Stone and Brick Masons' Edition. By H. G. Richey, Superintendent of Construction U. S. Public Buildings. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Leather; 4 × 7 ins.; pp. 255; 232 illustrations in the text. $1.50.

The above-noted volume is the third of a series of handbooks that the author has published on the various building trades, the other two being a general reference book for architects and building inspectors and a carpenters' and woodworkers' edition of the building mechanics' handbook. Like the other two, the present book is a very complete and handy compendium of the various details of construction which are parts of the practical knowledge of the trade. There is no attempt at involved mathematical discussion. It consists principally of descriptions of the various materials, methods of laying out work, standard rules in brick, stone and concrete construction, and tables of weights and measures; in short, the information which an experienced builder learns after many years of work, or at least what he learns to need, for his memory may not serve him so well as a well indexed handbook.

GUIDE TO SOME OF THE PUBLIC WORKS OF FRANKFORT-ON-THE-MAIN.—Published by the City Engineer's Department, Frankfort-on-the-Main, Germany. Stiff paper; 7½ × 11 ins.; pp. 79; illustrated.

After a brief historical account of this old and interesting city, the earliest authentic mention of which is in 794, there are described and illustrated in considerable detail the streets and roads, cleansing and sewerage, sewage disposal works, the water supply and harbor works of the city. Finally there is outlined the method followed in laying out new parts of the city. In his preface City Engineer Koelle states that the "Guide" has been prepared for the benefit of the many "representatives of other municipalities and specialists" from his own country and abroad who visit Frankfort. He adds that a larger publication describing the public works of Frankfort, issued in 1903, is too bulky to serve the purpose for which this "Guide" is intended, inasmuch as it "goes into details, which can only be of interest to specialists in the various branches dealt with." It also appears from the preface that the "Guide" is printed in German and in French, as well as in English. The production is certainly a most creditable one, the plan of which might be copied to advantage by many other cities, both abroad and at home. It gives a considerable amount of interesting and useful information on the municipal works of Frankfort, and does it in handsome style.

STANDARD SPECIFICATION PARAGRAPHS.—(U. S. Reclamation Service, Department of the Interior.) Washington, D. C.: Pub. Doc. Paper; 8¼ × 10½ ins.; pp. 28.

The U. S. Reclamation Service has been doing excellent work for several years past in standardizing and otherwise improving its specifications, office and field methods, reports, etc. In our issue of April 25, 1907, we published an article on cost-keeping, outlining standard methods formulated by the Service, and in our issue of June 13, 1907,

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we published some "Notes on Preparing Specifications" emanating from the same source. The pamphlet before us contains a form for calling for proposals, notice to bidders, blanks for bids, and the detailed specifications for a canal and tunnel. The work covered includes canal excavation, an earth dam, a timber-and-concrete lined tunnel, lumber, concrete, cement, steel for reinforcing, structural steel, cast-iron, and vitrified pipe. Doubtless the specifications will be of interest and service to many engineers and contractors outside the Reclamation Service.

Peat and Its Manufacture.

PEAT: ITS USE AND MANUFACTURE.—By Philip R. Björling and Frederick T. Gissing. London, England: Charles Griffin & Co., Ltd. Cloth; 5¼ × 8 ins.; pp. 173; 61 illustrations, partly in the text. 6s., net; American price, $2.40, net.

The statements, periodically heard, that the American coal supply will not last more than a century longer repeatedly draw attention to peat as an available fuel. The possible importance of the widely scattered deposits of this comparatively unknown fuel is also recognized in other parts of the world. Naturally, at each of the locations where the peat industry is being developed comparatively little is known about the conditions in other quarters. This necessarily has caused the meager literature that has appeared to be a collection of writings on disconnected specific phases of the subject rather than comprehensive views. It is doubtful if there is possible a more comprehensive view of the field in a small volume than is given in this one. The material is, of course, largely compiled, but with more detail than one would think possible.

In the first 36 pages is given the more general matter on the formation, growth and distribution of peat beds, on the specific gravity and composition of peats from various parts of the world and on methods of digging, cutting and dredging peat from the bogs.

In the latter part of the portion on cutting and dredging a presentation of the principles of modern peat processes and machinery is begun, to be maintained to the end of the volume. After presenting the general matter the authors pass into the major part of their work, which deals with manufactured fuel. Here "manufactured peat" is defined as any that is not cut into regular blocks at the beds, but that is macerated, treated in any way and finally formed into blocks of any shape or size. In the 82 pages of this particular chapter all the exploited or published methods are described, largely with reference to line cuts and half-tones of the apparatus. These processes are classified in order of simplicity, from those employing simple hand machines to the Kilberry plant in County Kildare, Ireland. This electrically-operated plant is complete with excavators, light railways, centrifugal dryers, kneaders and molders.

A dozen pages are added on the nature and proper uses of peat as a fuel, with a discussion of the incomparability of results. Under this head the reasons for failure and lack of uniformity are shown to lie largely in attempts to burn this comparatively light material under grate and draft conditions suitable for coal.

Throughout the book there is an evident attempt to show the degree of success attained in the different processes. The authors state that they have presented failures as well as successes in order that future workers may not be obliged to repeat the latter. There is appended a bibliography and list of patents, relating to peat working, issued since 1900.

DIRECTORY OF PORTLAND CEMENT MANUFACTURERS OF THE UNITED STATES.—Corrected to Aug. 1, 1907. Compiled and Published by C. Earle E. Bottomley, Secretary of the Association of American Portland Cement Manufacturers. Philadelphia, Pa.: The Association. Leather; 3 × 5¼ ins.; pp. 96. $1.

This directory lists under the incorporated names of the companies the firms now manufacturing Portland cement in this country, together with what information is available concerning projected mills. The capitalization, officers and estimated production of the factories are also given. This estimated production is somewhat misleading, as it is computed, presumably, by multiplying the size of each rotary mill by the number of mills and the number of days in a year, and thus does not take into account breakages or delays. The annual output of each firm, as given in the directory, is therefore largely in excess of its actual production; otherwise the book gives information both authentic and useful. Its value would have been greatly increased if an alphabetical index of the brands of cement had been appended; the name of the manufacturing firm is not nearly so well known as the name of the cement it makes.

VERTICAL LIFT-LOCK ON WATERWAYS FOR BARGES AND VESSELS.—System: "Oelhafen-Loehle." Translated and adapted from the French by Prof. K. E. Hilgard, M. Am. Soc. C. E., Consulting Engineer, Zurich, Switzerland: Schiffshebewerk, A.-G. Paper; 9 × 11½ ins.; pp. 8; 11 illustrations in the text.

A remarkable novelty in canal-locking appliances is described in this pamphlet, apparently in the interests of the patentees and the company formed to exploit it. A lift lock suspended by cables passing over sheaves at the top of a pair of towers, counterweighted to reduce the operating power, is the means of communication between upper and lower reach. The novelty or "improvement" which characterizes the "System Oelhafen-Loeh'e" is a device for preventing accident to the lock-tank by falling or too rapid rising, as when a cable breaks or the water runs out of the tank. The device is a great cylindrical framework, below or above the tank, and with its vertical axis in the axis of the tank. Its diameter is several times the width of the tank. The framework or drum is adapted to move up and down between the towers, whose inner faces are curved to correspond. This drum acts as a screw, the curved parts of the towers constituting its nut. A helical track of steel rail is formed on the inner face of the tower. This is engaged normally by spring-mounted wheels on the outer face of the drum, and when the drum is rotated at a speed suitable to the vertical speed of the suspended structure, the wheels roll downward or upward along the helical track. But when the vertical speed becomes excessive, the load on the wheels becomes great enough to force them back against their springs, and flat shoes attached to the drum then come to bearing on the track, thus holding the structure from further motion.

READY OCTOBER 21

Principles of Reinforced Concrete Construction

BY

F. E. TURNEAURE, *Dean of the College of Engineering, University of Wisconsin*

E. R. MAURER, *Professor of Mechanics, University of Wisconsin*

In the present volume the authors have endeavored to cover in a systematic manner those principles of mechanics underlying the design of reinforced concrete, to present the results of all available tests that may aid in establishing coefficients and working stresses, and give such illustrative material from actual designs as may be needed to make clear the principles involved. 8vo, viii + 317 pages. Cloth, $3.00.

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The Madeira and Mamore River R. R. in Brazil.

RECOLLECTIONS OF AN ILL-FATED EXPEDITION TO THE HEADWATERS OF THE MADEIRA RIVER IN BRAZIL.—By Neville B. Craig. In Cooperation with Members of the Madeira and Mamoré Association of Philadelphia. Philadelphia and London: J. B. Lippincott Co. Cloth; 5½ × 9 ins.; pp. 479; 28 plates and 6 maps. $4, net.

This book is as entertaining as a novel. It is the story of one of the most remarkable enterprises in all the annals of American engineering. Thirty years ago a firm of American contractors undertook the work of building a railway for 250 miles along the Madeira River in Brazil, in a region cursed with malarial fevers and remote from all population and supplies.

The enterprise is one of enormous commercial importance, as the proposed railway would afford connection between a network of navigable rivers in Bolivia thousands of miles in extent and the steamers which ply on the lower Madeira and Amazon and thus communicate with the outside world. To this day, all traffic between Bolivia and the Atlantic coast has to pass by canoe over 250 miles of the upper Madeira River with portages around no less than 15 rapids and falls where the canoe and its freight must be dragged by human muscle, under the difficulties incident to a torrid climate, dense wilderness and tropical diseases.

Had the enterprise been successful, the map of South America might have been changed, American influence and trade in South America would have received an immense stimulus and millions of dollars worth of business might have been brought to the United States that has been captured by England and Germany.

The book before us, however, concerns itself much more with the human interest of the story, than with the larger issues involved. It is a plain tale of the adventures, trials and exploits—of the sufferings and privations—undergone by a party of resolute pioneers—American engineers, contractors and railway builders in a year of heroic endeavor in the deadly climate of the Amazon valley.

The year 1878 when this expedition went forth was a period of hard times in engineering work. New enterprise was at a standstill. The opportunity to undertake this work in Brazil, therefore, was eagerly embraced by a number of the brightest young engineers then in active work. Many of these survivors of the Madeira & Mamoré River expedition occupy to-day places in the highest ranks of the engineering profession. We may mention among those whose names are particularly well known among engineers, Messrs. C. W. Buchholz, Othniel F. Nichols, F. A. Snow, Geo. W. Creighton, C. S. De Invilliers and Wm. C. Wetherill.

That the expedition failed of success was no fault of the engineers who directed it. Briefly stated, the financial backing of the enterprise, which at the outset was supposed to have the Bolivian Government behind it, proved faulty. Collins Bros., the contracting firm which undertook the work, lost over $800,000 and were driven into bankruptcy. The party of Americans who had gone to Brazil suffered hardships compared with which the loss of salaries or wages was trifling.

As one reads the book, however, he is not impressed with the doleful side of the picture but with the splendid view it gives of men working with heroic energy under conditions the most discouraging—tropical heat, fever, insects, scanty food supply, lack of medicines, deficient quarters, no pay, and little prospect of any—and yet month in and month out this little band of Americans struggled on with the same grim heroism that has inspired many a party of soldiers or sailors leading a forlorn hope in the hour of battle.

The book is a very welcome contribution to the history of American engineering enterprise. It ought to be and doubtless will be read by every engineer who contemplates undertaking work on the new project for building the same old road on which an American company is now engaged. Certainly every American engineering school should have a copy of the book. The young engineer will learn things from it that are found in none of the standard text-books, but which are even more necessary for his highest success than anything in his Mechanics or Chemistry.

The following extract from one of the concluding chapters of the book will be appreciated, we are sure, by our readers:

Of the 941 persons who left this country for San Antonio in 1878 it is absolutely certain that at least 23.6% lost their lives. The significance of this statement will be more apparent when we reflect that the mortality resulting from accident, wounds and disease, among the Union soldiers during our four years of bloody civil war was only 10½%. This comparison carries with it a lesson for those, whom music, gilt braid and brass buttons have hypnotized into believing that only in military life is there to be found any adequate field for the display of physical courage and endurance.

In an oration delivered at Harvard University a few years ago William Everett said: "There are more heroic and sacrificial acts going on in the works of peace every day than the brazen throat of war could proclaim in a twelvemonth." Let the reader who doubts this assertion compare the statistics just given with those of our late war with Spain. During that conflict the death rate in the American army, from all causes, was only 1%, or about half that frequently observed in a single year among the peaceful residents of our large cities. Only three employees of P. & T. Collins were killed by savages, but even that small number gives a death rate more than double that due to injuries inflicted by Spaniards upon the American troops in 1898.

At the end of a campaign of seven weeks in Cuba, General Shafter's army, victorious in war, was so completely demoralized, cowed and conquered by malarial fever that 90% of the soldiers were unfit for duty, and many of the officers signed a round robin urging the Government to bring them home. In the face of much greater proportionate mortality, it required a year and a half to starve the unpaid railroad men of 1878 into a complete abandonment of the enterprise in which they were engaged. Even then the rear guard of determined men only left San Antonio when compelled to do so by positive orders from their superiors at home.

* * * * For years to come, army promotion, retirement from active service upon liberal salaries and pensions will continue to follow those who were engaged in the opera bouffe warfare of 1898. Time has mitigated the humiliating spectacle presented by groups of gushing girls waiting at railway stations to perform previously unheard-of feats of osculation upon a young naval hero who made an abortive attempt to bottle the Spanish fleet in the harbor of Santiago, but we may even yet see a general at the head of our armies, who obtained his military training in a medical school, fought in Cuba the only trouser-wearing foes he ever encountered and reached the climax of a brief but brilliant military career at the indiscriminate massacre of men, women and children in the crater of Mount Dajo.

The railroad men, who, in 1878, risked life and health in a vain endeavor to develop, by peaceful methods, vastly greater latent wealth than any which exists in the Philippines, have long since been forgotten. There was nothing of a spectacular character to attract public attention in their prosaic attempt to establish direct commercial intercourse between this country and the interior of South America. A minute fraction of the money wasted in and in consequence of the war with Spain would have changed their failure into a brilliant success, would have established a permanent community of interest between ourselves and the nations south of us, would have given us a commanding influence in the commerce of the two Americas and would have caused the consignment of the Monroe Doctrine to the rubbish heap, as a useless expression of the proposed attitude of the United States under certain conditions, which could not by any possibility occur.

The actors in the drama of 1878 had none of the requisites essential to enduring fame. They wore no gaudy uniforms, carried no flaunting battle flags, required no strains of martial music to make them forget danger in the performance of duty and had no retinue of newspaper correspondents to chronicle the death of every mule which fell a victim to their accurate gun fire.

To-day many of them are still to be found employed, in positions of great responsibility, on railways and public works in the United States, South America and Mexico, but, as one by one they pass to their eternal camping ground, no American flag drapes their coffins and no farewell volley is fired over their graves. Such honors are the exclusive prerogative of those who consecrate themselves to the destruction of human life and the dissipation of human energy.

Mr. L. J. Mensch, Monadnock Building, San Francisco, asks us to announce that he can supply no more copies of his "Handbook on Reinforced Concrete Construction," as nearly the whole edition was burned in the San Francisco fire.

Suburban Railway Surveys

This important subject is treated in a 25-page chapter of Lavis' treatise on "Railroad Location, Surveys and Estimates." Mr. Lavis writes from personal experience on suburban rapid transit location, and his discussion of this subject can not fail to be of value to every civil engineer who is interested in this important branch of railway work. The other chapters of this book by Lavis are also written out of his experience in railway location not only in the East, far West and South, but in the tropics. Although it is a new book, several engineering colleges have adopted it as a text-book, and a thousand practicing railway engineers have purchased it. No book of its kind has received such favorable reviews by railway papers and the technical press generally.

"Railroad Location, Surveys and Estimates," by F. Lavis, M. Am. Soc. C. E., is a 270-page book, price, $3 net, postpaid.

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Water-Works Science and Finance Made Easy.

CLEAN WATER AND HOW TO GET IT.—By Allen Hazen, M. Am. Soc. C. E. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 5¼ × 8 ins.; pp. 178; 25 plates. $1.50; English price, 6s. 6d., net.

To an active-minded person a pleasure trip on the Atlantic may become tedious before England is reached. It can readily be understood that a vigorous engineer called to take the much longer voyages to and from Australia would need something more serious than shuffleboard and cards for diversion. Mr. Hazen, in his recent trip to Brisbane to aid the water board of that city in securing better works, whiled away some of the long hours on the Pacific by drawing from his rich fund of experience and observation some of the principles—common-sense, technical and financial—to be followed in obtaining and paying for a plentiful supply of clear water.

In his preface, the author does his book and himself injustice by dwelling too strongly on its elementary character, and by stating that the book is for mayors and aldermen rather than for water-works superintendents and members of water boards. But the book abounds with facts and suggestions that will be new and valuable to, even the veterans of the water-works fraternity. Not all water-works superintendents and commissioners are veterans, and few indeed, whether veterans or novices, can fail to learn, if they only will, from this little book. To the class for which the author says it is specially intended the book may be of the utmost value. That class includes "those who have power to act, and to act in a way to bring about better conditions," namely, "mayors and aldermen who have great responsibilities" in the matter of making it possible for water-works officials to provide pure water.

It is not necessary to follow out the contents of the book in great detail. The author first reviews water supplies from impounding reservoirs, small and great, from lakes, rivers and the ground. He then discusses the action of water on iron pipes, bringing out points that will be new and valuable to experienced engineers, as well as to superintendents of works. The history of water purification in America and the nature of purification processes are outlined, after which comes a particularly valuable chapter "On the Application of the Methods of Water Purification, Arranged According to the Matters to be Removed by the Treatment." The water-works commissioners or superintendents who cannot, by the aid of this chapter, add considerably to their store of practical knowledge are few and far between. Chapters on the storage of filtered water, the required sizes of filters and of other parts of water-works, on pressure and on the use and measurement of water—all useful—are followed by a treatment of financial aspects and of laying out and building works. The final chapter, and one of the best in the book, is "On the Financial Management of Publicly-Owned Water-Works." It broadly outlines a rational scheme of water-works accounting, advises charging city departments and private consumers for water supplied, assessing city taxes on water-works property, and earning a moderate profit on the *equity* of the works, or the difference between outstanding bonded indebtedness and the book value of the works. The last-named proposition is perhaps the most novel one in the book. It corresponds with a company's dividend on its capital stock, or would if such dividends were based on what many believe to be a just capitalization. The justification for aiming to secure such a profit is well put by the author. His plan really differs from that practiced by some municipal works chiefly in that it is scientific, and would be based on a proper system of accounting, while most works base their profits, if made, on guesses and chances, or the cut-and-try method, rarely knowing whether what they term is a profit is such or whether the works are losing money instead—the loss being covered by some little-understood or perhaps practically unknown method.

We have touched on only a few of the many good points of the book, but enough, we trust, to convince our readers of its value and to aid in giving the book the wide reading that it deserves.

PRACTICAL SANITATION.—A Handbook for Sanitary Inspectors and Others Interested in Sanitation. By George Reid, M. D., D. P. H., Fellow and Examiner of the Sanitary Institute. With an Appendix on Sanitary Law by Herbert Manley, M. A., etc., Medical Officer of Health, County Borough of West Bromwich. Twelfth Edition, thoroughly revised. London, England: Charles Griffin & Co., Ltd. Cloth; 5 × 8 ins.; pp. 351; 106 illustrations in the text. 6s.; American price, $2, net.

This book has worthily won recognition in its earlier editions, on both sides of the Atlantic, as being an unusually complete and reliable handbook for sanitary inspectors. Of course it would be far more useful in this country if subjected to revision and curtailment by some one thoroughly familiar with American sanitary engineering and health-protective work. Altogether too much space is given, from the American viewpoint, to descriptions of various proprietary devices and methods of carrying out engineering work, with which American health officers, at least, have little or no concern. Passing over the numerous descriptions of proprietary devices, we may call attention to the fact that a paragraph is given to "Norton's Abyssinian tube well," and another paragraph to Angus Smith's coating for cast-iron pipes, subjects scarcely belonging in a book for sanitary inspectors.

It is not easy to determine, without detailed comparison with earlier editions, how thorough revision has been given to the book in the present edition. The author states in his preface that the book has been revised, and that the chapter on sewage disposal "has been practically rewritten." There is evidence to support the last statement, but judging from certain remarks on page 32 it does not look as if the general revision of the book had been very thorough, for here the author, in speaking of the use of bisulphate of soda as a means of sterilizing water employed during the "recent African war," adds, "but with what success has not yet been made known." A foot-note refers to a periodical volume dated 1900-01. Of course this may merely be an oversight. In general, however, an examination of the volume indicates that it is very well up to date.

COMPUTATION AND MENSURATION.—By P. A. Lambert, M. A., Professor of Mathematics, Lehigh University. New York: The Macmillan Co. Cloth; 4¾ × 7¾ ins.; pp. 92; 26 figures in the text. 80 cts., net.

The author of this little volume is evidently one who has been impressed by the general inability of first-year college students to make an extended or independent application of what they have learned in the ten or twelve years of their fundamental schooling. The advanced work, particularly in a technical school, is for the acquisition of applied and correlated knowledge rather than abstract wisdom. The transition is difficult for most boys and some never thoroughly pass over. In no particular branch of study is this more evident than in engineering mathematics. To facilitate the transition here the author has arranged a short course on Computation and Mensuration.

The ten chapters, in order of presentation, are entitled: Approximate Computation, Graphic Computation, Method of Co-ordinates, Volumes of Solids Bounded by Planes, Use of Trigonometric Functions, Use of Logarithms, Limits, Graphic Algebra, Areas Bounded by Curves, Volumes of Solids. These headings give in a general way the subject matter of the book. Greatest attention is given to concrete applications of principles. The solution of characteristic problems is illustrated and several additional are given for solution at numerous points throughout.

In most engineering schools the more experienced instructors have been able generally to accomplish the transition by practical reviews of the algebra, geometry and trigonometry with specific application of the principles to common problems—of an engineering nature invariably. To such this book will not appeal. By the younger and less experienced instructor, who has not realized the necessity of practical reviews, this book should be welcomed, although as he gathers experience and method he will be apt more and more to leave this text for an original arrangement. If the volume even starts an instructor in such a direction it will not have been published in vain.

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Ten thousand contractors and engineers have bought one book, and a very great percentage have subscribed for the paper edited by the author of that book. We refer to Gillette's "Handbook of Cost Data," and to "Engineering-Contracting," the latter being a weekly periodical for civil engineers and contractors. The "Handbook of Cost Data" has broken all records for the sale of an engineering book, because it is full of detailed costs of all kinds of actual construction. The handbook contains 622 pages, bound in leather, and its price is $4 net, postpaid. "Engineering-Contracting" is $2 a year (52 copies), but for a short time $1 will be accepted for a full year's subscription.

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STATE SEWERAGE COMMISSION (New Jersey).—Report to the Legislature of 1907. (Charles W. Fuller, Chairman Commission.) Cloth; 5½ × 9 ins.; pp. 277; folding and other plates.

A considerable amount of interesting information regarding many of the sewage purification plants of New Jersey is included in this report. Some of this information is given in a brief special report made by Prof. Earle B. Phelps, of the Massachusetts Institute of Technology; some is included in reports of the chemist and bacteriologist employed by the Commission; and the greater part of the descriptive matter is given in an account of 30 disposal plants prepared by Mr. Boyd MacLean, Secretary of the Commission.

LINING OF DITCHES AND RESERVOIRS TO PREVENT SEEPAGE LOSSES.—By Elwood Mead and B. A. Etcheverry. Bulletin No. 188. Agricultural Experiment Station, University of California. Sacramento, Cal.: Pub. Doc. Paper; 5¾ × 9 ins.; pp. 385 to 420; 15 illustrations in the text.

After describing several types of lining in actual use and giving considerable cost data, this bulletin describes experiments with various ditch linings made on the University of California experiment farm, some four miles from Modesto, Cal. At this point, 12 ditches, 2½ ft. deep, 50 ft. long on top and 42½ ft. long at the bottom, side slopes of 1½ on 1, and a bottom width of 2 ft., were dug. Four of them were left unlined, and eight were lined with cement concrete, cement mortar and cement plaster, cement lime concrete, puddle, and road oil; the latter lining, with variations, being used on several ditches. The results of the tests are given in tabular form, and include not only the efficiency ratios of the several linings, but their cost per square foot.

906 Pages of Concrete Data

The most recent and, by all odds, the most complete treatise on the subject of concrete and reinforced concrete contains 906 pages and 715 illustrations and drawings. This treatise has 108 pages on reinforced concrete buildings alone, exclusive of the chapters on the design of columns, beams, etc. It contains 50 pages on reinforced concrete sewers, conduits and pipes. It contains 90 pages on concrete bridges, exclusive of the chapter on bridge piers and abutments. In short, Reid's "Concrete and Reinforced Concrete Construction" is the one book that no concrete engineer or contractor can afford to be without. In spite of the great cost of producing this book, its price is only $5 net, postpaid.

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Publications Received.

BULLETINS, U. S. GEOLOGICAL SURVEY.—Charles D. Walcott, Director. Washington, D. C.: Pub. Doc. Paper; 5¾ × 9 ins.

No. 304: Oil and Gas Fields of Greene County, Pa. By Ralph W. Stone and Frederick G. Clapp. Pp. 110; 3 plates (one in pocket) and 7 text figures.

No. 313: The Granites of Maine. By T. Nelson Dale. With an Introduction by George Otis Smith. Prepared in Cooperation with the Maine State Survey Commission. Pp. 202; 14 plates (one in pocket) and 39 text figures.

No. 317: Preliminary Report on the Santa Maria Oil District, Santa Barbara County, California. By Ralph Arnold and Robert Anderson. Pp. 69; two plates (one in pocket) and one text figure.

No. 318: Geology of Oil and Gas Fields in Steubenville, Burgettstown, and Claysville Quadrangles, Ohio, West Virginia, and Pennsylvania. By W. T. Griswold and M. J. Munn. Pp. 196; 13 plates (9 in pocket).

No. 320: The Downtown District of Leadville, Colorado. By Samuel Franklin Emmons and John Duer Irving. Pp. 75; 7 plates (one in pocket) and 5 text figures.

COMMISSIONER OF LABOR.—Annual Report, 1906. Strikes and Lockouts. (Charles P. Neill, Commissioner.) Washington, D. C.: Pub. Doc. Cloth; 5½ × 9¼ ins.; pp. 979.

CYCLOPEDIA OF ARCHITECTURE, CARPENTRY AND BUILDING.—A General Reference Work on Architecture, Carpentry, Building, Superintendence, Contracts, Specifications, Building Law, Stair-Building, Estimating, Masonry, Reinforced Concrete, Steel Construction, Architectural Drawing, Sheet Metal Work, Heating, Ventilating, etc. Prepared by a Staff of Architects, Builders and Experts. In Ten Volumes. Chicago, Ill.: American School of Correspondence. Cloth; 6½ × 9¾ ins.; pp. (total) 3,913; numerous plates and text illustrations. Introductory price, $19.80; list price, $60.

DIE DAMPFKESSEL.—A Text-book for Students of Technical Colleges and a Manual for Engineers. By F. Tetzner, Professor in the Royal Mechanical College at Dortmund. Third Edition, improved. Berlin, Germany: Julius Springer. Cloth; 6 × 9½ ins.; pp. 200; 38 plates and 149 text illustrations. 8 marks; American price, $3.20.

DRUCK- UND GESCHWINDIGKEITS-VERHAELTNISSE DES DAMPFES IN FREISTRAHL-GRENZTURBINEN.—By Dr. Oskar Recke. Munich and Berlin, Germany: R. Oldenbourg. Paper; 5¾ × 9¼ ins.; pp. 118; 3 plates and 67 text illustrations. 2½ marks; American price, $1.

EINFUEHRUNG IN DIE GEODAESIE.—By Dr. O. Eggert, Professor in the Technical College at Danzig. Leipzig, Germany: B. G. Teubner. Cloth; 5¾ × 9 ins.; pp. 437; 237 illustrations in the text. 10 marks; American price, $4.

EXCAVATING MACHINERY USED FOR DIGGING DITCHES AND BUILDING LEVEES.—By J. O. Wright, Supervising Drainage Engineer, Irrigation and Drainage Investigations. Circular 74, Office of Experiment Stations, A. C. True, Director, Washington, D. C.: Pub. Doc. Paper; 5¾ × 9 ins.; pp. 40; 16 illustrations in the text.

FOREST LAWS (Massachusetts).—By F. W. Rane, State Forester. Boston, Mass.: Pub. Doc. Paper; 3¼ × 5½ ins.; pp. 39; illustrated.

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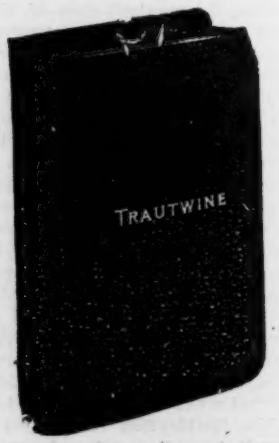

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